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02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW 1661

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES 1666

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics

04 AIRCRAFT 1667

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

05 ASTRONOMY AND ASTROPHYSICS 1670

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For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

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For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

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For related information see: 14 Human Behavior; and 28 Space Radiation.

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For related information see: 07 Chemistry; and 27 Propulsion.

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Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

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For space biology see: 16 Life Sciences.

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33 STRESSES AND LOADS 1757

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For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

34 STRUCTURAL DESIGN 1760

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

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Scientific and Technical Aerospace Reports

A Semimonthly Publication
of the National Aeronautics and Space Administration

November 8, 1963

01 GENERAL

Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

N63-20733 General Electric Co., Santa Barbara, Calif.
ECONOMICS OF THE TRADE-OFF AMONG RELIABILITY, MAINTAINABILITY AND SUPPLY
A. S. Goldman, H. P. Kramer, W. H. Root, and T. M. Whitlin
June 20, 1962 126 p 15 refs
(RM-26TMP-42)

Support systems specifications are discussed from a design and management point of view. The report includes: (1) the economic theory of choice, i.e., how to minimize costs of reliability and maintainability for selected levels of availability; and (2) alternative methods of resolving the problem of choice in determining optimal combinations of reliability, maintainability, and availability on a system or less-than-system level of analysis. Three approaches to determining an optimal allocation of resources in system development are presented. C.L.W.

N63-20906 Joint Publications Research Service, Washington, D.C.
WHAT IS AN ASTRONAUT?
Sept. 6, 1963 13 p Transl. into ENGLISH from Dnevnik Letchika Kosmonavta, No. 2, Dec. 1962 p 22–26
(JPRS-20967; OTS 63-31700) OTS: $0.50

This is a story of the development and training of an astronaut in the U.S.S.R. P.V.E.

N63-20996 Space Technology Labs., Inc., Redondo Beach, Calif.
INDEPENDENT RESEARCH PROGRAM ANNUAL PROGRESS REPORT – CALENDAR YEAR 1962
1962 541 p refs
(STL-9990-6363-RU-000)

Progress is reported in the following areas: (1) applied mechanics, including low thrust trajectory optimization, feasibility of the electrically suspended gyroscope, failure criteria for pressurized cylinders, flow interaction on lifting reentry, orbit determination, and dynamic photoelasticity; (2) electron and ion physics, including microwave electronics, ion propulsion, photography of plasmoid rotation and azimuthal rotation of the shock wave from an exploding wire, and far ultraviolet light source development; (3) solid state and quantum effects, including alkali vapor frequency standards and frequency drift, quantum interactions of solids, thin film insulators, laser research, and quantum optical properties of selected organic compounds; (4) space physics, including space instrument development, geophysical laboratory experimentation, and space environment studies; (5) thermal, chemical, and energy conversion, including hydrazine catalysts, bipropellant rocket engine research, and multilayer cryogenic insulation performance; (6) communication and information theory, including X Band CW Radar, wide angle antennas, signal synchronization by computer, oscillator instability, accuracy of direction-finding systems, adaptive telemetry, microminiaturization, solid state power generation, and human dynamic response; and (7) mathematics and computers, including digital data processors, numerical analysis and automatic programming. M.P.G.

N63-21001 Advisory Group for Aeronautical Research and Development, Paris (France)
AGARD PUBLICATIONS INDEX – 1952-1962
A. G. Vannucci and F. A. Blake comps. (Min. of Aviation, Gt. Brit.) 1962 317 p 1630 refs

AGARD publications are indexed by the nature of the publication, subject, and author. A brief abstract of each publication is included. M.P.G.

N63-21076 Royal Norwegian Council for Scientific and Industrial Research, Blindern
DANISH – NORWEGIAN ROCKET RESEARCH [DANSK – NORSK RAKETTFORSKNING]
Odd Dahl et al [1963] 44 p 2 refs In NORWEGIAN; ENGLISH Summary
(NSRC 1)

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N63-21077 Royal Norwegian Council for Scientific and Industrial Research, Blindern

COOPERATION IN ROCKET RESEARCH

Odd Dahl and K. Holberg (Norweg. Defence Res. Estab., Kjeller) *In its* Danish-Norweg. Rocket Res. [1963] p 1–5 In NORWEGIAN; ENGLISH Summary (See N63-21076 21-01)

The European Launcher Development Organization (ELDO) and the European Space Research Organization (ESRO) are described. These organizations are considered the first steps toward placing Europe in a position of making better scientific contributions, of taking part in current space-technology developments, and in reaping the benefits therefrom. Norway's position as a member in these organizations, and the consequences thereof, are discussed. Author

N63-21126 National Aeronautics and Space Administration, Washington, D.C.

PROCEEDINGS OF THE CONFERENCE ON SPACE-AGE PLANNING. A PART OF THE THIRD NATIONAL CONFERENCE ON THE PEACEFUL USES OF SPACE, CHICAGO, MAY 1-9, 1963

1963 272 p

(NASA SP-40) GPO: $2.00

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N63-21134 National Aeronautics and Space Administration, Washington, D.C.

THE RESEARCH BASIS FOR FUTURE SPACE PROGRAMS

Raymond L. Bisplinghoff *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 73–79 (See N63-21126 21-01)

Four principle areas, where research is required if the U.S. is to achieve preeminence in aeronautical and space activities in the decades to come, are discussed. These areas are as follows: (1) energy conversion and propulsion; (2) structural materials; (3) control, guidance, and communications; and (4) space sciences and the environment of space. I.v.L.

N63-21137 National Aeronautics and Space Administration, Washington, D.C.

INTERNATIONAL COOPERATION IN SPACE EXPLORATION

Arnold W. Frutkin and Richard J. H. Barnes *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 101–111 (See N63-21126 21-01)

Progress made within the past year in international cooperation in space is as follows: (1) the launching of the first international satellites and the joint planning and execution of scientific sounding rocket programs; (2) the participation of upwards of three dozen countries in cooperative projects relating to communications and meteorological satellites; (3) the establishment of regional organizations in Europe for peaceful space activity; (4) the achievement of a unique agreement between the U.S. and the U.S.S.R. for coordinated space activities; and (5) the substantive U.N. action to facilitate an international range in India. I.v.L.

N63-21138 Illinois U., Urbana

CONTRIBUTIONS OF EDUCATIONAL AND RESEARCH PROGRAMS TO MANPOWER AND ADVANCES IN SPACE SCIENCES

Frederick Seitz *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 117–123 (See N63-21126 21-01)

Universities can contribute to advances in the space sciences in the following areas: (1) engineering which includes the practical aspects of power conversion, communications, and the properties of materials and structures; (2) the development of somewhat specialized knowledge concerned with man's responses to his environment; (3) sociological, legal, and economic problems associated with space exploration; (4) matters relating to the upper atmosphere of the earth; (5) matters relating to the inorganic compositions of such satellites as the moon and the planets; (6) extraplanetary astronomical observations that become possible once one is above the atmosphere rather than under or in it; (7) the basic laws of physics, particularly those covered under the designations of special and general relativity; and (8) biological aspects of the origin of life. I.v.L.

N63-21139 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

UNIVERSITY RESEARCH ACTIVITIES AND THEIR IMPACT ON THE NATIONAL SPACE PROGRAM

William H. Pickering *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 125–130 (See N63-21126 21-01)

Universities have contributed to the national space program in the following areas: (1) investigation of the properties of gaseous plasmas; (2) studies of the fundamental chemical properties and behavior of fuel cells; (3) research to establish methods of systematic structural synthesis; (4) theoretical studies of the solar wind; (5) studies of closed ecological systems; and (6) studies of lunar soil mechanisms. Also, the development of the Jet Propulsion Laboratory is discussed. It was initially intended as a field station to conduct rocket and jet propulsion studies for graduate students in the Aeronautics Department of the California Institute of Technology. In 1958, it was transferred to NASA, and is presently responsible for the Ranger, Surveyor, and Mariner projects. I.v.L.

N63-21140 Chicago U., Ill.

GOALS AND THE UNIVERSITY

George W. Beadle *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 149–151 (See N63-21126 21-01)

To prepare for research growth in space exploration, the University of Chicago is planning for expenditures in the near future of some $41 million for new buildings and facilities. In 1963, ground was broken for a NASA-financed, interdisciplinary space research center. At the Argonne National Laboratory, a $48-million atom smasher, more formally known as the Zero Gradient Proton Synchrotron, will be completed in 1963. Also, at Argonne, scientists and engineers are designing new and more sophisticated power reactors and nuclear propulsion systems for space vehicles. I.v.L.

N63-21141 Real Estate Research Corp., Washington, D.C.

THE ECONOMIC EFFECTS OF THE SPACE PROGRAM

Anthony Downs In NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 153–158 (See N63-21126 21-01)

Because the space program represents the intermingling of the most advanced modern technology with large-scale Government and industrial planning, it must inevitably move U.S. economy in the direction of more centralized control and planning. It should be kept in mind, however, that the space program represents less than 1 percent of the total economic output. Even so, the impact of this one percent can be, and will be greatly magnified by its effects in speeding up technical research and its employment effects in certain specific areas. I.v.L.

N63-21142 Small Business Administration, Washington, D.C.

IS THERE A FUTURE FOR SMALL BUSINESS IN THE SPACE AGE?

John E. Horne *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 159–163 (See N63-21126 21-01)

Nearly 95% of the businesses in America are small businesses, some 4 1/2 million of them; they represent 40% of our total business activity. Some contributions of small businesses to the space program are as follows: (1) the production of parts for the Gemini space capsule; (2) the building of NASA's S-16 Orbiting Solar Observatory and the development of new products in the process; and (3) nearly 80% of the suppliers for the communications satellite, Telstar, were small firms. I.v.L.

N63-21143 Federal Communications Commission, Washington, D.C.
FREE ENTERPRISE IN SPACE
Newton N. Minow *In* NSA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 165–170 (See N63-21126 21-01)

The Communication Satellite Act of 1962 authorizes the creation of a private corporation for profit, subject to substantial Government regulation. The corporation will build and operate a commercial communications satellite system, in partnership with foreign governments and businesses. I.v.L.

N63-21144 National Aeronautics and Space Administration, Washington, D.C.
SPACE TECHNOLOGY AND ITS POTENTIAL FROM AN INDUSTRIALIST'S VIEWPOINT
Earl P. Stevenson *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 179–183 (See N63-21126 21-01)

One of the most significant aspects of the space program is that it spreads across the entire industrial spectrum—electronics, metals, plastics, fabrication technology, ceramics, machinery, automation, instruments, controls, materials, heat transfer, data handling—to sample only a few. The most critical problem facing the U.S. is the more rapid development and diffusion of technology. At present, NASA has three programs for dealing with this problem. One of these programs is a semimonthly publication, Scientific and Technical Aerospace Reports. A second, the Office of Technology Utilization is concerned with the identification and appraisal of innovations made in the course of NASA's "in-house" operation. The third is university grants. The universities will explore mechanisms whereby the progress and research results achieved in space science and technology, may be fed into industry and segments of the economy with which the university normally has close relations. I.v.L.

N63-21145 National Aeronautics and Space Administration, Washington, D.C.
THE NASA PROGRAM OF INDUSTRIAL APPLICATIONS
Louis B. C. Fong *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 185–190 (See N63-21126 21-01)

The basic objectives of the Technology Utilization program are discussed. These objectives are: (1) the identification of innovations (means of accomplishing a work objective either more effectively than before or for the first time); (2) the cataloging of documentation; and (3) the analysis and dissemination of innovations to industrial users. I.v.L.

N63-21146 Midwest Research Inst., Kansas City, Mo.
HOW COMPANIES HAVE TURNED SPACE TECHNOLOGY INTO INDUSTRIAL PROFITS
Howard M. Gadberry *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 191–198 (See N63-21126 21-01)

Some industrial applications of space-related concepts are as follows: (1) Thiokol has developed, out of research to improve the casting of large solid-propellant rockets, simple and economical procedures for casting polysulfide printing rolls which are superior ink carriers, plus being tough, wear-resistant, and easily repaired if damaged. Rollers of this type have been found particularly useful for can-printing and other high-speed press operation. (2) Printed cable wiring used in missile systems has been used in automobile printed-cable dashboard wiring. (3) High-purity sintered aluminum-oxide ceramics used in nose cones and rocket nozzle inserts have replaced steatite rods in the manufacture of miniature wound resistors, solving the breakage problem. (4) Magnetic field methods, used in the Saturn program, to shape metal have been extended to expanding or shrinking tubes to make pressure-tight joints. (5) Air bearings used in the space program for high-speed gyroscopes, frictionless supports, inertial guidance, and stable platforms are being used for isolating delicate microbalances from the vibrations of nearby machines. (6) The methods, standards, and visual aids developed by NASA regarding soldering reliability have been used in oil prospecting and well logging. (7) The Rogallo flex-wing concept developed for booster recovery or for the glide-landing of space capsules has been applied to the construction of inexpensive space-age sports gliders. (8) The shaping and forming of large metal parts by means of explosives, as used in aerospace industries, is now being used by metalworking firms. I.v.L.

N63-21147 Barnes Engineering Co., Stamford, Conn.
AN INDUSTRIAL DERIVATIVE FROM THE SPACE PROGRAM
R. Bowling Barnes *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 199–203 (See N63-21126 21-01)

Three industrial products which are direct derivations of defense and space work are discussed. These products are the infrared micrometer, the infrared radiation thermometer, and the infrared camera, or thermograph. I.v.L.

N63-21148 National Aeronautics and Space Administration, Washington, D.C.
HOW NASA SELECTS AND MANAGES PROGRAMS
Robert C. Seamans, Jr. *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 215–223 (See N63-21126 21-01)

NASA has programs in the following areas: manned spaceflight, space sciences, applications, advanced research and technology, and tracking and data acquisition. Responsibility for coordinating and directing the planning of each project lies in the program offices. A project plan, including procurement aspects, is prepared for each project. Each project is approved by NASA's general management and, following this approval, the cognizant center director is made responsible for the conduct of the proposed activity, for the technical and business administration of the contract, and for the signoff for the agency when the contract is completed. For every procurement of $1 million or more, a source evaluation board is appointed to evaluate all companies participating in the procurement competition. It is a NASA policy to give small businesses every possible chance to participate in the procurement opportunities of the space program. I.v.L.

N63-21149 North American Aviation, Inc., Downey, Calif.
THE PRIME CONTRACTOR'S ROLE IN THE NATIONAL SPACE PROGRAM
John Leland Atwood *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 225–230 (See N63-21126 21-01)

NASA provides prospective bidders with a kind of multidimensional envelope of requirements, such as weight, payload, length of time for the mission, and so forth. Within this envelope the prime contractors competing for the program will design a system, present a plan for developing it over a period of time, and provide cost estimates. Once the contract is awarded, there begins a continuing technical coordination between NASA, the contractor, and the subcontractors in creating the system. This coordination continues throughout the

course of the program. The contractor proposes improvements to the design on the basis of knowledge gained during the development program. I.v.L.

N63-21150 Minneapolis-Honeywell Regulator Co., Minn.
THE ROLE OF THE SUBCONTRACTOR
Charles L. Davis *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 231–234 (See N63-21126 21-01)

The subcontractor's role is not simply the production of known parts and devices on schedule; it is, rather, having the capability to use specialized knowledge and inventiveness toward the solution of a problem, and then creating new designs of hardware to perform a special function in an extreme and unusual environment. This holds true whether a subcontractor supplies components, simple apparatus, complex subsystems, complete systems, or pure knowledge. I.v.L.

N63-21152 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MANAGEMENT OF THE SPACE PROGRAM AT A FIELD CENTER
Wernher von Braun *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 239–250 (See N63-21126 21-01)

The Marshall Center retains a technical direction for all of its research and development contracts, including those placed and administered by other government agencies. To ensure daily personal contracts and to promote a sure, clear line of communication, the Saturn office locates resident managers in the plants of each prime contractor. If the resident manager finds a problem beyond the scope of his staff, he returns it to the Saturn Office. This office can draw on the technical knowledge of its nine in-house divisions. The keystone of Marshall's contractor management is daily personal contact with the contractor by the resident manager. This contract is supported, however, by formal contractor reporting requirements. I.v.L.

N63-21153 National Aeronautics and Space Administration, Washington, D.C.
NASA PROCUREMENT POLICIES
Ernest W. Brackett *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 259–264 (See N63-21126 21-01)

A booklet has been published entitled "Selling to NASA" which gives the name of each center, some description of what it buys, the name and phone number of the top procurement man and of the small business specialist at each center, as well as information about the procurement system. If a company is interested in contracting with NASA, it should file, with each procurement office with which it wishes to do business, a Standard Form 129. This will place the company on the research center's source list for the field of contracting in which it specializes. In order that companies may know where to go for subcontract work, a synopsis of each research and development procurement estimated to cost over $100,000 is placed in the Department of Commerce Business Daily. The synopsis also lists the names and addresses of the companies to which "requests for proposals" are being sent. This affords companies seeking subcontracts an opportunity to sell their products or services to prospective prime contractors before those companies prepare their proposals and line up their principal subcontractors. I.v.L.

N63-21154 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
IMPACT OF THE LEWIS RESEARCH CENTER ON MIDWEST INDUSTRY
Walter T. Olson *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 265–273 (See N63-21126 21-01)

The major tasks of the Lewis center are research and advanced technology in propulsion and power for space flight. In the fiscal year 1963, approximately $389 million of NASA's $3.7 billion budget will have been spent from Lewis. The Lewis Center influences Midwest industry by offering participation in the technologically orientated work of the space program, and by the industrial applications of the results of its space research. I.v.L.

N63-21342 Congress. Senate. Committee on Aeronautical and Space Sciences
NASA AUTHORIZATION FOR FISCAL YEAR 1964. PART 1: SCIENTIFIC AND TECHNICAL PROGRAMS
James E. Webb et al Washington, U.S. Govt. Print. Off., 1963 24–30, 779 p Hearings before Comm. on Aeron. and Space Sci., Apr. 1963
(88th Cong. 1st Sess., S. 1245 Committee Print) GPO: $2.25

Hearings were held before the Committee on Aeronautical and Space Sciences of the United States Senate on a bill to authorize appropriations to the National Aeronautics and Space Administration for research, development, and operation; construction of facilities; and for other purposes. P.V.E.

N63-21343 Congress. Senate. Committee on Aeronautical and Space Sciences
NASA AUTHORIZATION FOR FISCAL YEAR 1964. PART 2. PROGRAM DETAIL RESEARCH, DEVELOPMENT, AND OPERATION; CONSTRUCTION OF FACILITIES; AND FOR OTHER PURPOSES
Clinton P. Anderson Washington, U.S. Govt. Print. Off., 1963 282 p Hearings before Comm. on Aeron. and Space Sci., June 12, 13, 17, and 18, 1963
(88th Cong. 1st Sess., S. 1245 Committee Print) GPO: $1.00

Hearings were held before the Committee on Aeronautical and Space Sciences of the United States Senate on a bill to authorize appropriations to the National Aeronautics and Space Administration for research, development, and operation; construction of facilities; and for other purposes. P.V.E.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: **03 Aerodynamics of Wings, Rotors and Control Surfaces; and 11 Fluid Mechanics.**

N63-20819 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
A REFLECTION METHOD FOR THE CALCULATION OF THE SUBSONIC FLOW REGION ASSOCIATED WITH SMALL ANGLE OF ATTACK BLUNTED AXISYMMETRIC BODIES FOR $M_\infty \gg 1$
C. R. Ortloff July 30, 1963 81 p 24 refs
(Contract AF 04(695)-169)
(TDR-169(3230-11)TR-3; SSD-TDR-63-156)

Inviscid flow about a blunted, axisymmetric nose at a small angle-of-attack is treated by the simplified reflection principle of Garabedian, in order to transform the governing equations to a symmetric-hyperbolic system. A stable, finite, difference scheme is given (and truncation errors presented) whereby a Cauchy problem in the transformed space is derived for the inverse problem considered. In the transformed, higher dimensional space, body and shock are given as constant-value coordinates, which considerably simplifies subsequent numerical and theoretical considerations. A section on Friedrichs' symmetric, positive operators is included to illustrate the application of the method to the problem considered. Author

N63-20822 Naval Ordnance Lab., White Oak, Md.
THE USE OF AUTOFRETTAGED LOOSE BARREL LINER CONSTRUCTION FOR HYPERVELOCITY LAUNCHERS
V. C. D. Dawson and A. E. Seigel Sept. 1963 17 p
(NOLTR 63-78; Ballistics Res. Rept. 99)

The extremely high muzzle velocities (12,000 to 30,000 fps) attained by gun-type hypervelocity launchers increase the barrel erosion and wear to such levels that a very low firing life is available. Thus, the cost of employing these launchers in a research program, because of high replacement costs and low life expectancy, becomes excessive. This report treats the possibility of using the loose liner barrel construction as a means of reducing these costs, and shows that employment of autofrettaged liners offers distinct advantages. Author

N63-20864 Aerodynamische Versuchsanstalt, Göttingen (W. Germany)
ENGINES — AERODYNAMICS OF TURBOMACHINES Proceedings of the [Fourth] Meeting of the Committees on Aerodynamics and Engines of the [German] Scientific Society for Aviation, Aachen, November 2-3, 1961 [TRIEBWERKS-AERODYNAMIK DER TURBOMASCHINEN Bericht Uber Die [Vierte] Sitzung der Ausschusse Aerodynamik und Triebwerke der Wissenschaftlichen Gesellschaft für Luftfahrt Am November 2.-3., 1961 In Aachen]
F. W. Riegels, ed. [1962] 165 p 143 refs In GERMAN
(AVA Res. Rept. 62-02)

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10. THE FLOW-PICTURE IN A TWO-STAGE AXIAL-FLOW COMPRESSOR H. Hoppe (Junkers Flugzeug u. Motorenwerke A.G.) p 139–148 1 ref (See N63-20874 21-02)

11. THE BEHAVIOR OF TL-POWER ENGINES DURING WINDMILLING A. Schaffler (MAN-Turbomotoren G.m.b.H.) p 149–160 (See N63-20875 21-02)

N63-20865 Technische Hochschule Carolo Wilhelmina, Brunswick (W. Germany) Inst. für Stromungsmechanik
SECONDARY FLOW LOSS AT AXIAL TURBINE CASCADES [UNTERSUCHUNGEN UBER DIE SEKUNDAREVERLUSTE DER BESCHAUFELUNG AXIALER TURBOMASCHINEN]
K. J. Bauermeister and G. Hubert *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines [1962] p 4–22 12 refs In GERMAN (See N63-20864 21-02)

A survey is presented of research on secondary loss in incompressible flow. This research was conducted at the Aerodynamic Institute of the German Research Institute for Air Travel and at the Braunschweig College of Technology. The survey includes discussions on the: (1) effect of Reynolds number on secondary loss; (2) effect of turbine-blade height ratios on the loss value; (3) effect of turbine-blade spacing on secondary loss; (4) effect of turbine-blade loading on secondary loss; (5) decrease in flow return at turbine cascades; and (6) polar curves of a turbine cascade of finite blade height. I.v.L.

N63-20866 Siemens-Schuckertwerke, A.G., Mulheim (W. Germany)
COMPARATIVE INVESTIGATIONS OF THE SECONDARY FLOW OF A CASCADE-COMPRESSOR IN THE CASCADE TUNNEL AND IN PHASE [VERGLEICHENDE UNTERSUCHUNGEN DER SEKUNDARSTROMUNG EINES VERDICHTERGITTERS IM GITTERKANAL UND IN DER STUFE]
L. Speidel *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines [1962] p 23–34 7 refs In GERMAN (See N63-20864 21-02)

Investigations were conducted on a compressor cascade in a cascade tunnel and on single impellers for the purpose of examining the transferability of measurements of secondary flow in the cascade tunnel to the rotating turbine wheel. The investigations resulted in the following characterization of secondary flow: (1) The secondary flow depends primarily on the dimensionless pressure rise in the compressor cascade. (2) The changes in pressure rise in the cascade, occurring during secondary flow, are basically the result of the displacement effect of the secondary flow. It is indicated that: (1) The considerable decrease in pressure rise, due to the displacement effect of the secondary flow, observed in the cascade tunnel

did not occur in the rotating turbine wheel. Thus, the measurements made in the cascade tunnel are not transferable. (2) The maximum pressure rise achieved in the cascade tunnel had the same course over the turbine-blade spacing as was observed in the rotating wheel. Thus, the measurements made in the cascade tunnel are transferable. I.v.L.

N63-20867 Technische Hochschule, Aachen (W. Germany). Inst. für Turbomaschinen

FLOW MEASUREMENTS ALONG THE ROTATING BLADES OF A ONE-STAGE AXIAL TURBINE [STROMUNGSMESSUNGEN AN ROTIERENDEN SCHAUFELN IN EINSTUFIGEN AXIAL-TURBINEN]

W. Dettmering *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines [1962] p 35–55 1 ref In GERMAN (See N63-20864 21-02)

A series of tests conducted at the Institute of Turbomachines of the Aachen College of Technology on one-stage axial turbines are discussed. The first series of tests was concerned with the measurement of three-dimensional flow processes as a function of the turbine-blade height. The measurement program covered measurements at five different blade heights, at various Mach numbers and at high speed in plane in front of the guide wheel, between the guide wheel and the impeller, and behind the impeller; as well as pressure-distribution measurements at the guide vane and at the rotating blade. All measurements were made using three-hole cylinder probes. The measurements included pressure, temperature, flow angle, and particularly pyroelectric-conductor temperature measurements. The second series of tests was concerned with the measurements of flow processes on an impeller, excluding the effects of wall boundary layers by means of boundary-layer suction on the hub, as well as excluding the boundary-layer interference between the guide wheel and the impeller by means of a thin sheet-metal guide wheel blading far in front of the impeller. However, no results are reported for the second series of tests. Trans. by I.v.L.

N63-20868 MAN-Turbomotoren G.m.b.H., Munich (W. Germany)

THE SOLUTION TO DESIGN AND CALCULATION OF THE CASCADE ACCORDING TO THE STREAM LINE THEORY [DIE LOSUNG DER ENTWURFS- UND NACHRECHNUNGSAUFGABE DER SCHAUFELGITTER NACH DER STROMFADENTHEORIE]

N. Scholz *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines [1962] p 56–60 In GERMAN (See N63-20864 21-02)

Discussions of the solution to the design and calculation problems of cascades, according to the streamline theory, include: (1) the physical model of the streamline theory according to the singularity method; (2) the equation system for the streamline theory including the displacement effect of the blade; (3) the solution for a sheet-metal blade of uniform thickness with a sector skeleton; (4) blade loading up to 90% of the uniform blade width and sinking to zero at the blade trailing edge; (5) the velocity distribution of a turbine cascade with large deflection for two parabolic loads, whereby the square of the velocity of the average streamline is plotted; and (6) the linear ascending curve of the square of the velocity of an average streamline along the breadth of the cascade for a three-point deflection. I.v.L.

N63-20869 Deutsche Forschungsanstalt für Luftfahrt, Brunswick (W. Germany)

INVESTIGATIONS OF THE EFFECT OF PROFILE THICKNESS ON THE LOSS-FACTORS FROM CASCADE-COMPRESSORS AT HIGH SUBSONIC VELOCITIES [UNTERSUCHUNGEN UBER DEN EINFLUSS DER PROFILDICKE AUF DIE VERLUSTBEIWERTE VON VERDICHTERGITTERN BEI HOHEN UNTERSCHALLGESCHWINDIGKEITEN]

J. Bahr *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines [1962] p 61–65 11 refs In GERMAN (See N63-20864 21-02)

Loss factors of compressor cascades at high subsonic speed are investigated. The effects of Mach number and Reynolds number are separated. Results indicate that: (1) The effect of the Reynolds number increases, i.e., a higher loss factor with a decreasing Reynolds number occurs when blade profile thickness is increased. (2) The loss factor increases with increasing Mach number when the blade profile thickness is increased. This is particularly true for high Mach numbers ($Ma_1 \geq 0.7$). (3) The irregularity of the polar curves, particularly in the case of thick profiles at low Reynolds numbers, are due to the separation of the laminar boundary layer. I.v.L.

N63-20870 Aerodynamische Versuchsanstalt, Göttingen (W. Germany)

INVESTIGATIONS OF AN ULTRASONIC COMPRESSOR AND COMPARISON OF ITS MEASUREMENTS WITH CASCADE MEASUREMENTS IN A WIND TUNNEL [UNTERSUCHUNGEN AN EINEM UEBERSCHALLVERDICHTER UND VERGLEICH MIT GITTERMESSUNGEN IM WINDKANAL]

T. Hottner *In its* Engines—Aerodynamics of Turbomachines [1962] p 66–98 93 refs In GERMAN (See N63-20864 21-02)

A supersonic compressor was investigated in which the essential pressure rise resulted from a perpendicular compression shock in an impeller with supersonic flow. The guide wheel had subsonic flow. The blading of this compressor followed the design of a tested H. Ludwig model compressor. However, small changes were made in the model, such as nonuniform blade thickness, radial expansion of the impeller annulus cross section in the housing. With this modified model, a compressor ratio of $P_{05}/P_{\infty} = 1.7$ was attained under an adiabatic efficiency of 90%. This value could not be reproduced in a large-scale design, and the question is whether or not this is due to the small changes in the model design. Investigations as to the cause of the reduced output indicated that the compressor without a front guide wheel, in spite of the smaller power supply to the hub, attained about the same compression ratio and far better efficiency than in the case of a compressor with a front guide wheel. The compression ratio was $P_{05}/P_{\infty} = 1.7$ at an adiabatic efficiency of 80% as measured behind the impeller without front guide wheel. It is assumed that the pulsating velocity head of the supersonic impeller, which resulted from reciprocal depression of the front guide wheel, caused a decrease in efficiency. In addition, plate-type cascades and American research on various compressor types are discussed. I.v.L.

N63-20871 M.A.N. Werk, Augsburg (W. Germany)

THE RESEARCHERS' WISHES IN THE FIELD OF AXIAL COMPRESSORS [WUNSCHE DES PRAKTIKERS UND DIE FORSCHUNG AUF DEM GEBIETE DER AXIAL-VERDICHTER]

A. Garve *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines [1962] p 99–106 7 refs In GERMAN (See N63-20864 21-02)

Problems, in the area of axial compressors, which require more data for proper solution are as follows: (1) the size of the individual compressor stages; (2) the camber of blade height which would provide rugged and stable characteristics and efficiency under various load deviations; (3) more exact determination of Mach number and blade-thickness limitations which are defined by maximum deflection; (4) the optimal form for considering the development of the side-wall boundary layer and secondary flow in compressor construction; (5) the optimal construction method for limiting noise development; (6) the height of the pulsating portion of the blade stress during different operating conditions for different distances between successive cascades; (7) means of calculating the vibration stress inside and outside the resonance range; (8) the optimal distance between cascades; and (9) the type of blading which provides the largest aerodynamic damping. I.v.L.

N63-20872 Technische Hochschule Carolo Wilhelmina, Brunswick (W. Germany) Inst. für Stromungsmechanik

EXPERIMENTAL EXAMINATION OF A THEORETICAL CHARACTERISTIC FIELD CALCULATION FOR AXIAL-FLOW ENGINES, AS IN A PHASE COMPRESSOR [EXPERIMENTELLE NACHPRUFUNG EINER THEORETISCHEN KENNFELDBERECHNUNG FUR AXIALE STROMUNGSMASCHINEN AM BEISPIEL EINER VERDICHTERSTUFE]

E. Ackermann *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines [1962] p 107–121 9 refs In GERMAN (See N63-20864 21-02)

The blading of an axial compressor stage was calculated according to methods derived from the cascade theory. A test stand measurement on the computed stage was conducted to test these calculations. The calculated and the measured characteristics were in good agreement. A small difference occurred only at the flow deflection in the impeller. Here the measured deflection was 2% larger than the calculated value. This difference is probably due to the centrifugation of the boundary layer in the impeller, which was not considered during the calculation. Trans. by I.v.L.

N63-20873 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Inst. für Strahltriebwerke

FLOW CALCULATION THROUGH MULTI-STAGE TURBINES WITH SPECIAL CONSIDERATION TO THE UNTWISTED BLADE [BERECHNUNG DER STROMUNG DURCH MEHRSTUFIGE TURBINEN UNTER BESONDERER BERUCKSICHTIGUNG DER UNVERWUNDENEN BESCHAUFELUNG]

K. Bammert *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines [1962] p 122–138 4 refs In GERMAN (See N63-20864 21-02)

A comparatively simple calculation method is described which gives an extensive insight into the area of three-dimensional flow. In this method, relationships were simplified (thickness variations, homogeneous stages, similar velocity vector diagrams in the center section, etc., were given in advance) in order to determine the difference between the results obtained by the well-known streamline theory and those obtained by exact calculation. This method can also be applied to cambered blades and successive stages with various blade angles, conditions which exist in most turbomachines. Since computer programs can be used for such calculations, the minimum per-unit time presents no problem when the link $\delta c_t/\delta z$ and the friction and boundary-layer effects are included. The effect of separation and friction must be determined by measurements of multistage turbines before these effects can be taken as a basis for further calculations. It is to be expected that the boundary layer, strongly affected by friction and flow separation behind one stage, will have a strong effect on the flow in the successive stages. A test multistage turbine was built to study how these effects evidence themselves on the second and third stages. In addition, a particular objective, using the test turbine, was to determine what type of blade was most suitable for a particular application, based on the knowledge gained from calculations and experiments. Unfortunately, the necessary basis could not be established by measurements on stationary guide vanes, but was determined mainly from investigations on running turbines.

Trans. by I.v.L.

N63-20874 Junkers Flugzeug- und Motorenwerke A.G., Munich (W. Germany)

THE FLOW-PICTURE IN A TWO-STAGE AXIAL-FLOW COMPRESSOR [DAS STROMUNGSBILD IN EINEM ZWEISTUFIGEN AXIALVERDICHTER]

H. Hoppe *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines. [1962] p 139–148 1 ref In GERMAN (See N63-20864 21-04)

Extensive measurements were made of flow conditions in a two-stage test compressor. This compressor was built as a model compressor, and is part of a project for a multistage turbine-engine compressor. Extensive instrumentation enabled the conduction of flow-distribution measurements between the single cascades. All probes could be conducted in a radial direction by means of remote control. Since the mounting of the probes is on the annulus and not in the housing, the probes could be adjusted in a tangential direction. Thus, a series of measurements of both the blade height and the circumferential direction are possible. Trans. by I.v.L.

N63-20875 Man-Turbomotoren G.m.b.H., Munich (W. Germany)

THE BEHAVIOR OF TL-POWER ENGINES DURING WINDMILLING [DAS VERHALTEN VON TL-TRIEBWERKEN BEIM ANTRIEB DURCH DEN FLUGSTAU (WINDMILLING)]

A. Schaffler *In* Aerodynamische Versuchsanstalt, Göttingen Engines—Aerodynamics of Turbomachines [1962] p 149–160 In GERMAN (See N63-20864 21-02)

A basic procedure is presented for calculating the performance characteristics of a turbojet engine during starting by windmilling, with and without mechanical power supply, i.e., power consumption from outside (starter motor, generator, etc.). Essentially, this analog is intended for the performance calculation of a turbojet operating under load, with the special requirement that the compressor exit temperature is the same as the turbine inlet pressure. The all-component characteristic curves are necessary for the full solution, whereby the compressor characteristic curves up to very small rpm and partial-pressure conditions must be taken as less than one. The procedure is in T: s-diagram and compressure characteristic curves are discussed. The results are represented in a form which is independent of pressure and temperature. The reduced rpm $n/\sqrt{T_{01}}$, the reduced throughput $L_1\sqrt{T_{01}}/P_{01}$, and the reduced resistance S/P_e are represented as functions of the backedup pressure ratio p_{01}/P_∞ or the flight Mach number Ma_∞. Trans. by I.v.L.

N63-20947 California U., Berkeley Inst. of Engineering Res.

SUPPLEMENTARY CYLINDER DRAG DATA FOR TRANSITION FLOW CONDITIONS

G. J. Maslach July 1, 1963 12 p 2 refs
(Contract Nonr-222(45))
(AS-63-3)

Data from measurements of drag forces acting on cylinders normal to a rarefied gas flow in the transition and near-free-molecular flow range are presented. The experimental results

indicate a smooth transition from continuum drag coefficient values to predicted free-molecular-flow drag coefficients. Normalization of the measured drag values reveals a marked Mach-number dependency. P.V.E.

N63-21028 Aluminum Co. of America, Pittsburgh, Pa.
THE SUPERSONIC TRANSPORT PROGRAM. MACH 2-PLUS OR MACH 3?
John D. Harper [1963] 16 p Booklet

Technology and cost problems for Mach 2-plus and Mach 3 supersonic transports are compared. It is concluded that, at the present time, the development of the Mach 2-plus transport would be the more practical for the following reasons: (1) many of the technical problems have already been resolved with the development of the B-58; (2) fuels, operational engines, and proven aluminum alloys for the airframe already exist. The Mach 3 transport, on the other hand, presents new technical problems: (1) no engine for a Mach 3 plane has been developed and proved; (2) there are serious drag problems that threaten economical operation at Mach 3; (3) new or improved fuels and fuel systems that could withstand the temperature environment of a Mach 3 plane would have to be developed; (4) the primary airframe structure would have to be fabricated of some exceptionally heat-resistant metal not now being used for this purpose on any aircraft in production. E.K.R.

N63-21057 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DAMPING OF A 0.02-SCALE SATURN SA-1 MODEL VIBRATING IN THE FIRST FREE-FREE BENDING MODE
Perry W. Hanson and Robert V. Doggett, Jr. Washington, NASA, Sept. 1963 36 p 7 refs
(NASA TN D-1956) OTS: $1.00

The aerodynamic damping of the sting-mounted scaled aeroelastic model was determined at Mach numbers from 0.70 to 2.87 by using an electrical power-input method. Two other configurations were investigated: one was the basic scaled model with rigid stabilizing fins added, and the other was the basic scaled model with fins, but with a winged spacecraft replacing the nose cone of the basic model. The experimental results are compared with those of some applicable theoretical methods. Author

N63-21115 Northrop Corp., Hawthorne, Calif. Norair Div.
INVESTIGATION OF A METHOD FOR THE PREDICTION OF VIBRATORY RESPONSE AND STRESS IN TYPICAL FLIGHT VEHICLE STRUCTURE
R. W. White, K. E. Eldred and W. H. Roberts Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Aug. 1963 334 p 14 refs
(Contract AF 33(616)-8219)
(ASD-TDR-62-801)

The prediction of the vibratory response of a complex structure, such as an aircraft fuselage or missile, to a random external forcing function was the primary task of this project. Previous studies have indicated that priority should go to experimental studies, in particular the dynamically-similar structural model. The concept is presented along with a demonstration which includes design, construction, and test of such a model. The experimental tool under study will provide a reliability-by-design approach which shortens the design period by providing design inputs early in the development of a new system. The models will be especially useful in space-booster projects where different payloads are substituted. Substudies in support of modeling were conducted. Improved model laws and construction techniques were developed. Measured transfer function of complex structure, using excitation from noise sources, provided new definitions of vibration transmission in complex structure. Author

N63-21124 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio TAPCO Div.
ADVANCED INDUCER STUDY
H. B. Bosch, P. Cooper, and W. F. Stoermer May 24, 1963 169 p 23 refs
(NASA Contract NAS8-4006; Proj. 512-0X9440-08)
(NASA CR-50993; ER-5288) OTS: $12.00 ph, $5.27 mf

This advanced inducer study included both analytical investigations and an experimental test program. The major emphasis of the theoretical effort was to set up an analytical flow model. Mathematical methods and techniques were developed for a numerical solution of this model on a digital computer; both the FORTRAN listing and performance calculations obtained from this program are reported. Studies were completed in regard to loss distributions, dimensionless parameters, scaling laws, and correlation factors which, when combined with the velocity distributions obtained from the flow-field solution, form the basis for design criteria or performance evaluation of full-scale inducers. In the analytical work, a referee inducer was tested in both water and liquid hydrogen. The data obtained in over ten hours running time in the water loop, plus four usable liquid-hydrogen test-runs, are presented for the purpose of evaluating the theoretical results. Author

N63-21247 David Taylor Model Basin, Washington, D.C.
A SIMPLIFIED ANALYSIS OF THE HYDROELASTIC INSTABILITY OF A THREE-DIMENSIONAL HYDROFOIL
Michael E. McCormick Aug. 1963 24 p 9 refs
(Rept.r 1555)

Two-dimensional flutter equations are modified to approximate three-dimensional circulation and virtual mass conditions. This is accomplished by multiplying the circulation and virtual mass terms of the two-dimensional equations by appropriate factors. The circulation factor is the ratio of the three-dimensional to the two-dimensional steady-lift expressions. The virtual mass factor is the ratio of the three-dimensional to the two-dimensional virtual mass expressions. Results of the modified analysis are compared with results obtained experimentally for a foil with aspect ratio of 3.0, and analytically from the two-dimensional theory. Author

N63-21249 Aberdeen Proving Ground, Md. Exterior Ballistics Lab.
SPECTRUM OF THE PROBE GLOW IN A SUPERSONIC WIND TUNNEL LIGHTNING STORM
Anders S. Platou, Gerald B. Klebe, and Robert L. Rowe July 1963 44 p 7 refs
(BRL-Memo-1490)

When moist air is used in a supersonic nozzle, electrical effects are observed on a probe mounted in the nozzle. An ungrounded probe assumes a potential of several thousand volts; with a grounded probe, a blue-red glow appears on the tip. Emission spectra of this glow consist only of excited molecular nitrogen with no indication of the presence of oxygen or water. The condensation glow spectra are similar to those of a low-power ac arc under similar static pressure. Author

N63-21281 Stevens Institute of Technology, Hoboken, N.J. Davidson Lab.
IMPROVED FIRST-ORDER SUPERCAVITATING THEORY
P. Ward Brown Aug. 1963 21 p 8 refs
(Contract Nonr-263-20)
(R-971)

Conventional first-order supercavitating hydrofoil theory is reviewed, and it is shown that, by avoiding the usual linearization of the physical plane, general expressions for improved force coefficients may be obtained in terms of the conventional first-order coefficients. Specific examples are given including supercavitating flow about a cambered hydrofoil, a symmetric wedge, and a flat-plate hydrofoil with flap. Comparison with exact solutions shows that the improved first-order lift is generally within 5%, for angles up to 90°. Author

N63-21291 Royal Aircraft Establishment, Bedford (Gt. Brit.) Naval Air Dept.
RECENT WORK AT THE ROYAL AIRCRAFT ESTABLISHMENT ON HELICOPTER DYNAMIC LOADS, WITH PARTICULAR REFERENCE TO HIGH BLADE INCIDENCE PROBLEMS
A. E. Clarke 1963 21 p 9 refs Presented at the V.T.O.L. Dynamic Loads Symp., Buffalo, U.S.A. June 26–28, 1963

In studies of helicopter dynamic loads, the problem of rotor-fuselage interference was reduced to the calculation of pressures and forces on a circular cylinder in the presence of a simple two-dimensional vortex; agreement with experimental data was good. The problems of high-blade incidence are discussed in terms of basic nonlinear and nonsteady aerodynamics, induced velocity distribution, and the influence of three-dimensional effects on section characteristics. Tests of three-dimensional and nonsteady aerodynamic effects are evaluated, and their significance in helicopter design is discussed. E.K.R.

N63-21295 Aeronautical Research Council (Gt. Brit.)
FREE-FLIGHT MEASUREMENTS OF THE DYNAMIC LONGITUDINAL-STABILITY CHARACTERISTICS OF A WIND TUNNEL INTERFERENCE MODEL (M = 0.92 TO 1.35)
G. H. Greenwood London, HMSO, 1963 18 p 4 refs
(C.P. 648; supersedes RAE-TN-AERO-2798; ARC-23888) Available from HMSO: 3s

The dynamic longitudinal-stability characteristics of a standard wind-tunnel interference model have been investigated in free flight over a Mach number range of 0.92 to 1.35. Measurements of lift-curve slope and maneuver margin were obtained, and are compared with results from transonic-tunnel tests under low-blockage conditions. Author

N63-21299 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE EFFECT OF CAVITIES ON THE BUFFETING OF AIRCRAFT
J. E. Rossiter Apr. 1962 64 p 13 refs
(RAE-TM-AERO-754)

This paper examines the unsteady pressure fields in and around cavities in subsonic and transonic flow by reference to wind-tunnel tests, and discusses how the vibrational response of an aircraft to the resulting unsteady loads may be estimated. Author

N63-21303 Autonetics, Anaheim, Calif.
EFFECT OF GUST ALLEVIATION SYSTEMS ON DYNAMIC AIR LOADS
J. D. Balducci, F. L. Adams, and M. A. Schwartzberg [1963] 62 p 24 refs Presented at the VTOL Dynamic Loads Symposium, Buffalo, N.Y., June 26–28, 1963
(Supported by the Army)

This paper describes various system methods of alleviating air loads due to gusts. The effects of these gust-alleviation systems on the dynamic air loads are presented, and the analysis tools and techniques, and the criteria used for evaluation are described. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N63-20790 Army Missile Command, Huntsville, Ala. Redstone Arsenal
SERVO ANALYSIS OF AN INERTIAL PLATFORM
H. V. White July 11, 1963 43 p 5 refs
(RG-TR-63-3)

A series of servoanalysis techniques for a three-axis, inertially stabilized platform is included in this report. The methods used are not only applicable to the specific system described, but are adaptable for any system employing an inertial reference device. Both theoretical and practical programs for a variety of inertial systems have been devised. It is concluded that the techniques described produce a more valid analysis of an inertial platform system than any presented previously. Analysis methods used were Bode, root locus, closed-loop frequency response, and an analog-computer simulation. Author

N63-20818 Minnesota U., Minneapolis
THEORETICAL PARACHUTE INVESTIGATIONS Progress Report No. 24, 1 Dec. 1962 to 28 Feb. 1963
H. G. Heinrich, T. Riabokin, S. K. Ibrahim, E. L. Haak, R. J. Niccum et al [1963] 31 p
(Contract AF 33(616)-8310)

This report covers the following: (1) wake effects on the behavior of parachutes and other retardation devices behind large bodies; (2) investigation of basic stability parameters of conventional parachutes; (3) a theoretical study of supersonic parachute phenomena; (4) a theoretical analysis of the dynamics of the opening parachute; (5) a statistical analysis of extraction time, deployment time, opening time, and drag coefficient for aerial delivery parachutes and systems; (6) a gliding aerodynamic decelerator; (7) effective porosity studies of parachute cloths and ribbon grid configurations; (8) a study of the flow patterns of aerodynamic decelerators by means of the surface wave analogy; (9) the aerodynamic characteristics of the parachute-stabilized A-21 cargo container; (10) the determination of mass flow through parachutes with inherent geometric porosity; (11) stress analysis of the T-10 troop parachute; and (12) the aerodynamic characteristics of the cross and the wagon-wheel types of parachutes. I.v.L.

N63-20916 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Institut für Flugmechanik
ON SOME METHODS OF NON-STEADY AERODYNAMICS [UBER EINIGE METHODEN DER INSTATIONAREN AERODYNAMIK]
A. von Baranoff June 28, 1963 165 p 303 refs In GERMAN
(DFL-213)

Lectures on nonsteady aerodynamics in the light of eventual application to flight dynamics, given by the author in 1962 at the Institute of Flight Mechanics of the DFL, are enlarged upon. An extensive bibliography is presented of the area under study. Papers are not listed which place emphasis on areas other than aerodynamics. However, border areas (grid flow) and fundamental expansion of the aerodynamic theory (extension to nonlinear problems or to viscous flow) have been considered wherever possible. The same is true for statistical methods. Trans. by I.v.L.

N63-20969 Boeing Scientific Research Labs., Seattle, Wash.
THE EFFECT OF FRICTION ON OPTIMUM TWO-DIMENSIONAL WINGS IN LINEARIZED SUPERSONIC FLOW
Angelo Miele and Robert E. Pritchard Aug. 1963 34 p 7 refs
(Flight Sciences Lab. TR-78; DI-82-0277)

The problem of minimizing the zero-lift drag of two-dimensional wings in supersonic flow is considered, including the effect of friction. It is assumed that the distribution of pressure coefficients is that which results from the linearized theory, that the friction coefficient is constant, that the chord of the airfoil is free, and that any number of conditions is imposed on the thickness, the enclosed area, the moment of inertia of the contour, and the moment of inertia of the enclosed area. By means of the indirect methods of the calculus of variations, a general solution is obtained. Several particular cases are also considered. Author

N63-21257 Aeronautical Research Council (Gt. Brit.)
CHARTS OF PEAK AMPLITUDES IN INCIDENCE AND SIDESLIP IN ROLLING MANOEUVRES DUE TO INERTIA CROSS COUPLING
W. J. G. Pinsker London, Min. of Aviation, 1962 82 p Previously issued as RAE-AERO 2604 and ARC-20196
(ARC R&M 3293) London, HMSO: £1 12s 6d

Based on a series of systematic analog computations, charts are given for the determination of peak amplitudes in incidence and sideslip for a general family of rolling and rolling pullout maneuvers of aircraft subject to inertia cross coupling. The principal parameters governing the stability and response characteristics of aircraft in rolling maneuvers are discussed, and formulae and data are given for their determination. Author

04 AIRCRAFT

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N63-20774 Federal Aviation Agency, Atlantic City, N.J.
EVALUATION OF THE WAKE OF AN S-58 HELICOPTER Final Report
Robert H. Ahlers and William A. Hiering July 1963 101 p 3 refs

A brief exploratory study of air movements near the ground within the wake generated by a 12,000-pound Sikorsky S-58 helicopter was conducted under conditions of light and moderate winds. Windspeed instrumentation was used to measure wake speeds in a plane approximately perpendicular to the test-site surface wind. The smoke patterns induced by the wake were photographed in color and were used as the basis for correlation of wake-speed data. The highest wake velocities occurred during hovering flight. Although the wake speeds produced during forward flight were not as high as those produced in hover flight, they persisted in the air mass for a much greater time. Also, the speed of travel of the wake system toward the ground decreases as the helicopter forward speed increases. These wakes with their vortices drifted downwind approximately at wind speed. The maximum propagation of wake velocities upwind was approximately 85 feet. Author

N63-20824 Booz-Allen Applied Research, Inc., Bethesda, Md.
OPERATIONAL ANALYSIS OF THE USE OF AIR CUSHION VEHICLES IN SUPPORT OF THE ARMY'S OFF-ROAD LOGISTIC MISSION [July 1962-Feb. 1963]
R. Montes de Oca, W. J. Neff, P. J. Mettam, J. W. Locke, and P. G. Fielding Ft. Eustis, Va., Army Transportation Res. Command, Aug. 1963 241 p 64 refs
(Contract DA 44-177-TC-855)
(TRECOM-TR-63-37)

The feasibility, performance, and cost effectiveness of a family of air cushion vehicles (ACV) and air cushion trailers (ACT) are investigated. A standard off-road environment is developed and a typical Army off-road logistics mission defined. Through the use of a mathematical deterministic model, optimum vehicles, with and without wheels, are compared with conventional off-road vehicles in current use, and those contemplated for the 1965–70 time frame. Analytical expressions are developed for wheel performance in a variety of terrains, and the advantages of off-loading for optimum performance determined. A cost methodology is proposed and used for the purpose of comparing air cushion vehicles with other off-road vehicles and the Chinook helicopter. Results strongly indicate the necessity of fitting wheels to overland ACV's, and the need for reciprocating rather than turbine engines for lift and locomotion if the maximum cost effectivity is to be achieved. Author

N63-20842 Aerodynamische Versuchsanstalt, Göttingen (W. Germany)
STABILITY AND CONTROL
H. Schlichting [1961] 159 p 65 refs In GERMAN Proc. of the Third Meeting of the Comm. on Aerodyn. and Flight Mechanics, June 15–16, 1961
(AVA 61-04)

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8. AEROELASTIC EFFECTS H. Fingado (DVL) p 138–149 5 refs (See N63-20850 21-04)

N63-20843 Deutsche Versuchsanstalt für Luftfahrt, Mulheim An Der Ruhr (W. Germany) Inst. für Flugmechanik
THE PROBLEMS OF FLIGHT CHARACTERISTICS FROM THE AIRCRAFT MANUFACTURERS' VIEWPOINT [DIE PROBLEME DER FLUGEIGENSCHAFTEN IN DER SICHT DES FLUGZEUGBAUERS]
H. Findago *In* Aerodynamische Versuchsanstalt, Göttingen (W. Germany), Stability and Control [1961] p 4–11 2 refs In GERMAN (See N63-20842 21-04)

Discussions of the airplane designer's approach to stability and control include: (1) the treatment of flight characteristics of elastic airplanes according to the method of modified derivatives wherein the same degree of freedom is used as in the case of rigid airplanes; however, the numerical values corresponding to elastic airplanes are used for all of these derivatives (differential quotients); (2) the consideration of servocontrol and of the superimposition of individually measured magnitudes in regard to their effects on flight-control systems; (3) the problems concerning the effect of the highest and the lowest dynamic pressure on the reporting back of angular displacement to the flight-control system; and (4) the use of analog computers in simulating flight characteristics, using realistic structural elements, as an aid in determining the optimal characteristics for a control system. Discussions of the missile designer's approach to stability and control include: (1) the Mach-number range through which the missile passes; (2) the influence upon the value of the longitudinal moments of the angle of sideslip when the angle of incidence is large and the aspect ratios are small; and (3) difficulties encountered in testing the aerodynamic characteristics of missiles. I.v.L.

N63-20844 Aerodynamische Versuchsanstalt, Göttingen (W. Germany)
FLIGHT CHARACTERISTICS – REQUIREMENTS [ANFORDERUNGEN AN DIE FLUGEIGENSCHAFTEN]
J. Rotta *In its* Stability and Control [1961] p 12–29 5 refs In GERMAN (See N63-20842 21-04)

The effect of the following flight characteristics on aircraft stability and control is discussed: (1) rapid longitudinal oscillations under normal and emergency flight conditions; (2) negative static longitudinal stability; (3) phugoid oscillations; (4) lateral control; (5) aileron-yawing moments; and (6) directional stability. Also presented are discussions concerning aircraft flight characteristics in England, which include: (1) the influence of the guidance system on stability and control; (2) the primary operational zone which is characterized by the altitude and speed ranges and the loading conditions (total weight, the point of the center of gravity and the external loads); (3) design criteria for the control mechanism; (4) the operational speed; (5) the reaction of the entire flight body, including guidance and control systems, during maneuvers; and (6) the effect of longitudinal acceleration on the stability of the flight body. I.v.L.

N63-20845 Technische Hochschule Carolo Wilhelmina, Brunswick (W. Germany) Inst. für Stromungsmechanik
AERODYNAMIC STABILITY-DERIVATIVES [AERODYNAMISCHE STABILITATS-DERIVATIVA]
K. Gersten *In* Aerodynamische Versuchsanstalt, Göttingen (W. Germany), Stability and Control [1961] p 30–65 29 refs In GERMAN (See N63-20842 21-04)

Abstracts of lectures on aerodynamic derivatives at the AGARD meeting in Brussels from April 10, 1961, to April 14, 1961, are presented. Following reference to detailed data on aerodynamic derivatives, theoretical and experimental methods for determining nonsteady aerodynamic derivatives are also presented. It is indicated that there are many unsolved problems as to nonsteady aerodynamic derivates for the speed range which is close to the speed of sound. In addition, a detailed discussion is presented of the aerodynamic values and the pecularity (nonlinear behavior) of slender wings. The effects of aeroelasticity are not discussed in this report. Transl. by I.v.L.

N63-20846 Deutsche Versuchsanstalt für Luftfahrt, Mulheim An Der Ruhr (W. Germany) Inst. für Flugmechanik
HIGH LIFT CHARACTERISTICS [EIGENSCHAFTEN BEI HOCHSTAUFTRIEB]
H. Fingado *In* Aerodynamische Versuchsanstalt, Göttingen (W. Germany), Stability and Control [1961] p 66–74 3 refs In GERMAN (See N63-20842 21-04)

Three reports on aircraft stability and control are discussed. The first report, which deals with high-lift characteristics at low speed, discusses means of coping with pancaking with emphasis on the reaction of different wing profiles to pancaking. The second report, which deals with low-speed problems of high-speed aircraft, discusses the effects of pancaking on delta wings of low aspect ratio; the aerodynamic center of a delta-wing aircraft, and the effect of flight below the minimum drag speed on pilot performance. The third report, which deals with stability and control at high lift and low speed from the viewpoint of the pilot, discusses flight tests for determining the descent speed for landing approach and the limitation of descent speed for a short-takeoff aircraft, such as the Bréguet. I.v.L.

N63-20847 Weser-Flugzeugbau, G.m.b.H., Bremen (W. Germany)
OBSERVATIONS ON FLIGHT CONTROL, UNSTABLE AIRCRAFTS, SIMULATORS AND FLIGHT MOTIONS IN STALL CONDITIONS AND IN CRITICAL AREAS [EINIGES UBER FLUGREGLER, INSTABILE LUFTFAHRZEUGE, SIMULATOREN UND FLUGBEWEGUNGEN IM UBERZOGENEN ZUSTAND UND IN KRITISCHEN BEREICHEN]
H. Puffert *In* Aerodynamische Versuchsanstalt, Göttingen (W. Germany), Stability and Control [1961] p 75–110 10 refs In GERMAN (See N63-20842 21-04)

Reports discussed are as follows: (1) the place of the servomechanism in the design of aircraft with good flight characteristics; (2) the effect of servomechanisms on aircraft stability and control; (3) problems arising in adapting automatic controls to manned aircraft; (4) the determination of suitable aircraft response to automatic-control mechanisms; (5) an approach to the control of statically unstable manned aircraft; (6) poststall gyrations; (7) flight-control-system simulation; (8) the use of piloted flight simulators in general research; (9) the theory and application of in-flight simulators; (10) the application of analytical techniques to flight evaluation in critical control areas; and (11) the bucking of aircraft. I.v.L.

N63-20848 Entwicklungsring Sud, Munich (W. Germany)
DISTURBANCES CAUSED BY TURBULENCE AND INCIDENTAL OCCURRENCES [STORUNGEN DURCH TURBULENZ UND ZUFALLSEINFLUSSE]
H. Schaffler *In* Aerodynamische Versuchsanstalt, Göttingen (W. Germany), Stability and Control [1961] p 111–118 3 refs In GERMAN (See N63-20842 21-04)

Reports concerning the effects of turbulence on airplanes and rockets include discussions of the following: (1) a mathematical model for characterizing the reaction of an airplane to atmospheric turbulence both near and distant from the earth; this model follows closely the Bachelor analysis; (2) the use of the maximum length of the airplane, in the respective coordinate system, as the threshold wavelength in calculating flight motion in turbulent air; (3) the deviation of the flight path as a function of the control method; and (4) the optimization of the transfer function of a radar-controlled rocket which is steered toward a target airplane. This optimization considers the reduction of the rocket's normal acceleration, limiting the control effect and the rocket's normal acceleration, and the effect of the rocket's dynamic stability. I.v.L.

N63-20849 Entwicklungsring Sud, Munich (W. Germany)
NON-LINEARITY PROPERTIES INCLUDING CROSS COUPLING [EIGENSCHAFTEN VON NICHTLINEARITATEN EINSCHLIESSLICH "CROSS COUPLING"]
X. Hafer *In* Aerodynamische Versuchsanstalt, Göttingen (W. Germany), Stability and Control [1961] p 119-137 6 refs In GERMAN (See N63-20842 21-04)

Discussions on the nonlinear properties of airplanes and missiles include: (1) the influence of control mechanisms on the free-flight motion of airplanes—a contribution to the theory of nonlinear stability—which covers schema for the following systems of differential equations: the general system which includes the change in air density as well as the change in control; the system with six degrees of freedom at constant air density; and the system with five degrees of freedom neglecting the weight components. Also presented are an expression for the aerodynamic values; the effect of engine gyroscopic moments during elevator deflection (five degrees of freedom) on the nonlinear stability; maximum roll amplitudes during elevator deflection; a comparison between the values for the motion curve, as derived by various approximation methods and those values derived by the exact solution; a comparison between nonlinear stability at five and six degrees of freedom; motion curves for aileron deflection (five degrees of freedom); the effect of rolling inertial moments on the motion curves; the effect of Mach number on nonlinear aerodynamics during elevator deflection; the effect of changing the aerodynamic values for stability; the effect of directional stability on roll coupling; (2) the pitch-yaw-roll coupling of a missile with four low-aspect-ratio wings and four tailplanes resembling rudders; (3) aircraft performance tests of the Bréguet 940; and (4) mathematical models for missiles. I.v.L.

N63-20850 Deutsche Versuchsanstalt für Luftfahrt, Mulheim An Der Ruhr (W. Germany) Inst. für Flugmechanik
AEROELASTIC EFFECTS [AEROELASTISCHE EINFLUSSE]
H. Fingado *In* Aerodynamische Versuchsanstalt, Göttingen (W. Germany), Stability and Control [1961] p 138-149 5 refs In GERMAN (See N63-20842 21-04)

Discussions of reports on aeroelastic effects include: (1) the effect of elastic deformability on the landing speed of a fighter aircraft; (2) the influence of aircraft heating, due to high Mach numbers, on aeroelastic phenomena; (3) the torsional rigidity of a rigid aircraft; (4) a method for calculating the effect of aerodynamic derivatives deviations—this method uses the roots of the polynomial equation (eigenvalues) of a starting airplane as well as another determinant (which results from transformation); (5) two methods for studying the motion of a flexible missile—the changed derivative and the complete methods; (6) methods for calculating the effect of aeroelasticity on the logitudinal stability of a swept-wing subsonic transport; and (7) some static aeroelastic considerations of slender aircraft. I.v.L.

N63-20890 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SIMULATOR STUDY OF AIRSPACE REQUIREMENTS FOR THE SUPERSONIC TRANSPORT
Richard H. Sawyer, Washington, NASA, Sept. 1963 23 p 1 ref (NASA TN D-1964) OTS: $0.75

An investigation was conducted to study the horizontal airspace requirements for a supersonic transport during changes in heading at a VORTAC station. The vertical deviations from cruising altitude during turning flight were also studied. The investigation was made with use of a fixed-base aircraft simulator programed to represent a delta-wing supersonic transport having a canard control. Manual flight control was used to effect changes in heading up to 45° for bank angles of 15°, 30°, and 45°. The tests were conducted at a Mach number of 3.0 at an altitude of 67,000 feet. Measurements were made of the horizontal and vertical displacements from the flight path, and of the primary control deflections. Author

N63-20914 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (W. Germany)
THEORETICAL STUDIES OF THE TOLERANCE OF AUTOMOBILE SAFETY BELTS TO ABRUPT DECELERATIONS AND SHOCK TESTS [THEORETISCHE BETRACHTUNGEN UBER DIE VERTRAGLICHKEIT STOSSFURMIGER VERZOGERUNGEN UND STOSSVERSUCHE MIT ANSCHNALLGURTEN FUR AUTOS]
H. L. Vogt Apr. 1963 51 p 38 refs In GERMAN (DVL-266)

The theoretical basis of human tolerance to shock type deceleration forces is discussed. After a survey of the present use of safety belts in aircraft and automobiles, shock studies with safety belts were conducted in aircraft and automobiles at the Institute of Flight Medicine of the German Research Institute for Air and Space Travel. The deceleration was 3 to 4 g over a period of 0.1 sec. The behavior of the test subject in the belt was recorded by slow motion and by photographs. The shoulder-abdomen safety belt gave best support for sport pilots and sail planes. The three-point contact belt and the two-point contact belt gave the body good support in automobiles. The three-point contact belt is preferred because of the larger supporting area. Abdomen belts are not recommended for automobiles. The test results are discussed in the light of tests and experiences with safety belts in aviation. Trans. by I.v.L.

N63-21058 Booz-Allen Applied Research, Inc., Bethesda, Md.
THE APPLICATION OF MODULAR/SECTIONAL STRUCTURES TO GROUND EFFECT MACHINES [July 1961-March 1962]
Ft. Eustis, Va., Army Transportation Res. Command, June 1962 216 p 29 refs
(Contract DA 44-177-TC-727)
(TCREC-TR-62-41)

Structural configurations, materials, and criteria for GEMs in the Army's amphibious-transportation regime are reported. Emphasis is placed on maximizing the transportability by air and surface, and a modular design is proposed. The mission selected for application of design is the 15-ton Logistics-Over-The-Shore carrier. The environment is enumerated, and material properties are reported. The preferred design approach employs aircraft structural techniques, utilizes a simple deck arrangement with minimum secondary structure, and a colinear lift power-annular jet configuration. Author

N63-21266 Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.
HEAVING AND PITCHING MOTIONS OF SUPERVENTILATED HYDROFOIL CRAFT IN IRREGULAR SEAS
Richard P. Bernicker June 1963 29 p 10 refs
(Contract Nonr 263(20), Amend. 8)
(Rept.-958)

An experimental investigation of the heaving and pitching motions of a fully-ventilated, surface-piercing dihedral hydrofoil craft was performed to ascertain the validity of applying linear-superposition techniques. Tests were carried out in regular waves to obtain the response operators of the craft. The pitching and heaving motions were then measured in long-crested irregular seas and analyzed using spectral techniques.

It was found that the motion spectra in irregular seas could be predicted with reasonable accuracy using the regular-wave response operators with the wave spectrum of the sea. Author

N63-21292 Lincoln Lab., Mass. Inst. of Tech., Lexington
REDUCTION OF COMPUTATIONAL AND DATA TRANSMISSION REQUIREMENTS FOR TRAJECTORY ESTIMATION USING MULTIPLE SITES
Fred C. Schweppe Aug. 23, 1963 19 p 5 refs
(Contract AF 19(628)-500)
(MIT-22G-10)

Space vehicles in free fall are often tracked from tracking sites located at different points on the earth. Two basic techniques for estimating the trajectory from the combined tracking data are discussed. These techniques are related to the maximum likelihood procedure, but allow faster computation and do not require the transmission of all of the data to a common data-reduction center. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

N63-20691 Yale U. Observatory, New Haven, Conn.
DECAMETRIC RADIATION FROM JUPITER. I. SYNOPTIC OBSERVATIONS, 1957-1961
James N. Douglas and Harland J. Smith Repr. from Astron. J., v. 68, no. 3, Apr. 1963 p 163-180 36 refs
(NASA Grant NsG-73-60)

A review of the observational problem introduces the equipment and techniques used for monitoring Jovian decametric radiation. Assignment of rigid objective criteria to the definition of observing time and to Jupiter storm identification makes possible the tabulation not only of identified storms but also of times when Jupiter was positively not radiating toward the earth with a flux greater than 10^{-21} W m^{-2} cps^{-1} on the frequencies being monitored. From these data are derived occurrence frequency and occurrence probability statistics as functions of System III (1957.0) longitude, and of frequency and year of observation. The trilobed character of the occurrence probability histogram and the total absence of events from one quadrant are conspicuous, with corresponding implications for freedom from non-Jovian events. The 1959 minimum in occurrence probability appears to be real; coincidence with maximum geomagnetic activity is remarked. Structural characteristics of individual storms are briefly discussed, including amplitude fluctuations and the tendency for relatively sharp onset and decay of particularly strong activity. Peak radiated decametric powers between 10^{10} and 10^{11}W are indicated, depending strongly on the spectrum at the low-frequency end, although the average power is closer to 10^{8} to 10^{9}W. Improved upper limits on decametric emission from other planets and on the optical emission from Jupiter are noted. Author

N63-20715 N. Copernicus U., Torun (Poland) Astronomical Observatory
A STUDY OF GALACTIC STRUCTURE IN FOUR SELECTED FIELDS IN AQUILA-SAGITTA AND CASSIOPEIA, PART IIIc
H. Iwaniszewski Torun Praca Wydana Z Zasilku Polskie Akademii Nauk 1962 30 p 17 refs
(*Its* Astron. Obs. Bull. 30; Studia Soc. Sci. Torun. Sect. F (Astronomia) v. 3, no. 5, 1963)

Photographic and photovisual studies are made of interstellar extinction and distribution of stars in the Aquila Field. The mean errors of the photographic and photovisual magnitudes are given, and they amount to ±0.076 to ±0.098 for the photographic magnitude range 10.5 to 13 and for the photovisual system ±0.08. The mean error of spectral-class determination amounts to ±0.08 spectral class. J.R.C.

N63-20727 Kitt Peak National Observatory, Tucson, Ariz.
Monthly Report, Feb. 1963 [RESEARCH IN ASTRONOMY. 1. STELLAR 2. SOLAR]
[1963] 12 p

Research in astronomy, stellar and solar, is reported as follows: (1) A seeing meter for use at the solar telescope has been designed and built. The device operates as a solar image contrast analyzer. (2) The coudé spectrograph for the 84-inch telescope is fully designed and under construction. (3) Optimization of the design for the 5-inch aperture f/0.6 thick-mirror Schmidt camera for the 84-inch Cassegrain spectrograph was continued. Author

N63-20776 Paris Observatory, Meudon (France)
POLARIMETRIC OBSERVATIONS OF PLANETS AND SATELLITES Annual Summary Report No. 2, June 1, 1962-May 31, 1963
Audouin Dollfus [June 30, 1963] 15 p
(Contract AF 61(052)-508)
(AFCRL-63-864)

Progress reported in this period includes: (1) rehabilitation of an old 40-inch reflector and the coating of it with a thin polarization free layer of silver; (2) completion of a near-infrared polarimeter operating in the spectral range from 0.7 to 1.1 micron. P.V.E.

N63-20931 National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
BIRTH OF THE ELEMENTS
A. G. W. Cameron Repr. from Sky and Telescope, v. XXV, no. 5, May 1963 p 1-4
(NASA-RP-8)

The elements in the universe are suggested to have come from stars which blew up as supernovae and ejected the elements into interstellar space. The energy gained when a star shrinks is more than enough to support the outer layers. As the interior grows hotter, the lighter nuclei bombard one another energetically enough to fuse together in thermonuclear reactions. This supplies energy to radiate, and stops further contraction of the star for a considerable length of time, until the nuclear fuel is exhausted. Then the shrinking starts again, and the star's central temperature rises until the "ashes" of the first set of reactions can themselves react and generate more heat. This again stops the shrinkage while the new fuel is being exhausted. Then another contraction sets in; the whole pattern may repeat a number of times. P.V.E.

N63-20932 Maryland U., College Park
TABLES OF METEOR LUMINOSITIES
E. J. Opik Repr. from Irish Astron. J., v. 6, no. 1, Mar. 1963 p 3-11 3 refs
(NASA Grant NsG-58-60)
(Contrib. from the Armagh Obs., 38)

Detailed tables are published of absolute magnitudes of small meteors (less than 100 gm) not developing an air cap.

The luminous efficiency is calculated as consisting of three components: β_o due to atomic impact radiation; β_t due to atomic temperature radiation from the coma; and β_b due to blackbody radiation from the surface of the meteoroid. The first two components are supposed to involve a common (systematic) uncertainty factor of the order of 2 or 3; β_b strongly depends on the vapor pressure curve of the material, but for a given material may be reliable to about +50 or −30 percent; it is important only for slow meteors, artificial meteors, and fragments of space vehicles. Three structural types of meteoroids are covered separately: (a) the stony dustballs which are prevalent among visual meteors, (b) compact iron, and (c) compact stone meteoroids. The tables are arranged according to double entry by mass and velocity, for certain standard mean length of trail. Rules for adapting the magnitudes to other values of the length of trail are given. Author

N63-20933 California U., San Diego
ELECTRON PROBE MICROANALYSIS OF ORGANIZED ELEMENTS IN THE ORGUEIL METEORITE
Bartholomew Nagy (Fordham U.), Kurt Fredriksson, Harold C. Urey, George Claus (N.Y.U.), Christian A. Andersen and Joan Percy Repr. from Nature, v. 198, no. 4875, Apr. 13, 1963 p 121–125 21 refs
(NASA Grants NsG-98-60 and NsG-341; Contract AT(11-1)-34)

Electron probe X-ray microanalysis has shown that several of the organized elements contain major amounts of iron and, in addition, some chlorine and/or nickel. Morphologically less-well-developed microstructures are composed of hydrous iron–magnesium silicates. When powdered preparations of the Orgueil meteorite were boiled in 6 N hydrochloric acid for 1 hr, acid-resistant particles were obtained, which seemed to be residues of organized elements. It was deduced that these particles probably consist of carbonaceous matter because they contained none of the elements detectable by the electron probe (Z atomic number > 11) and because their average atomic number agreed with that of the epoxy plastic in which they had been embedded. The finding of iron with some chlorine and nickel in organized elements in a petrographic thin section of the Orgueil meteorite shows that these particles are very probably not terrestrial contaminations. Author

N63-20934 National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
THE EARLY EVOLUTION OF THE SUN
Dilhan Ezer and A. G. W. Cameron Repr. from Icarus, v. 1, nos. 5, 6, May 1963 p 422–441 15 refs
(NASA-RP-7)

Hayashi has predicted that the early contracting sun should be highly luminous and fully convective, if one makes a correct choice of the photospheric boundary condition in constructing solar models in the contracting stages. A sequence of models has been constructed which fully confirms his predictions. The maximum radius of the protosun consistent with gravitational stability is 57 $R_\odot$; this has a luminosity of about 450 times that of the sun. As the protosun shrinks, it stays fully convective until a radius of less than 3 $R_\odot$ is reached; the luminosity continues to decrease until a radius of 1.7 $R_\odot$ is reached. The sun requires about 2 million years to contract onto the main sequence, but this number is very uncertain because of the unsatisfactory state of convection theories. If the primitive solar material has the terrestrial ratio of deuterium to hydrogen, then a further 3×10^5 years is required to burn the deuterium. These numbers are very much less than previous studies had indicated. The degree of lithium burning in the outer convection zone of the sun is highly uncertain owing also to the unsatisfactory state of convection theories. Author

N63-21121 Harvard Coll. Observatory, Cambridge, Mass.
PLANETARY TELESCOPES
James G. Baker Repr. from Appl. Opt. v. 2, no. 2 Feb. 1963 p 111–129 30 refs
(NASA Supported)
(Harvard Repr. 11 195)

A review is made of present possibilities in the design of large refracting-telescope objectives intended for visual or detector-aided studies of the planets from ground-based observatories. The optical and environmental problems encountered are discussed, and several examples are given to demonstrate the degree of improvement to be expected from both semiapochromatic and fully apochromatic objectives. Author

N63-21190 Aberdeen Proving Ground, Md. Ballistic Measurements Lab.
CALIBRATION OF PC-1000 CAMERAS BY MEANS OF STAR PHOTOGRAPHY
Myron W. Lawrence Apr. 1963 29 p 5 refs
(BRL-Memo-1468)

Calibration of three PC-1000 cameras was performed utilizing approximate zenith exposures of stars. The calibration consists of determining the focal length, principal point, and lens distortion of each camera, and corresponding estimates of precision derived from a rigorous least-squares solution. Field work and data-reduction procedures are described. Graphical presentation of lens distortion, and a discussion of the results are included. Author

06 AUXILIARY SYSTEMS

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic, and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

N63-20723 Atomics International, Canoga Park, Calif.
SNAP 8 REACTOR AND SHIELD
C. E. Johnson and C. A. Goetz N.Y., Am. Inst. of Aeron. and Astronautics, 1963 30 p Presented at the AIAA Electric Propulsion Conf., Colorado Springs, Mar. 11–13, 1963
(Contract AT(11-1)-GEN-8)
(AIAA Paper-63033) AIAA: $0.50 members, $1.00 nonmembers

SNAP 8 is a nuclear powerplant intended to produce approximately 30 kw of electric power output for use in spacecraft. The system employs a nuclear reactor as the heat source for a mercury Rankine cycle power conversion system. The performance requirements, design, weight, and operating characteristics of the SNAP 8 reactor are summarized and a typical shield is discussed. The effects of spacecraft configuration and payload dose tolerance on shield weight for unmanned spacecraft are discussed. Approximate relationships are presented to facilitate rough estimates of shield weights for preliminary design studies of unmanned spacecraft employing the SNAP 8 reactor. Author

N63-20782 Northwestern Technological Inst., Evanston, Ill.
DEMON: DECISION MAPPING VIA OPTIMUM GO-NO NETWORKS. A MODEL FOR NEW PRODUCTS MARKETING
W. W. Cooper (Carnegie Inst. of Tech.), J. K. De Voe, D. B. Learner (Batten, Barton, Durstine and Osborn, Inc.), and A. Charnes July 1963 35 p 14 refs
(Contracts Nonr-1228(10) and Nonr-760(01))
(ONR Res. Memo.-79)

A rational marketing program (DEMON) for introducing a new product is described. This program is also generally applicable to situations where decisions under uncertainty must be made in the light of incomplete and not necessarily comparable data. A network formulation is used in which the links of the network represent research tasks and the nodes represent evaluations or decisions undertaken in the light of all prior information. At each node in the network, one of three choices is made in terms of previously stated objectives. These choices are "Go," "No," and "On." "On" indicates "continue testing," and an "On" decision must be made with consideration of (1) already accumulated information, and (2) every alternative route that remains for traversing the network. This network model considers the probabilistic nature of the data upon which the decisions must be based by using chance-constrained programing, and yet retains the flexibility needed to explore alternatives that might be discovered in the course of subsequent data gathering. M.P.G.

N63-20828 Lockheed Electronics Co., Plainfield, N.J. Military Systems
INVESTIGATION OF THREE-DIMENSIONAL DISPLAY TECHNIQUES Final Technical Report
S. S. Verner, R. Lipnick, and A. Sussman Mar. 30, 1963 130 p 30 refs
(AF 30(602)-2688/RASGD)
(RADC-TDR-63-202)

An extensive investigation of stepwise excitation of fluorescence was undertaken. Several binary systems involving mercury vapor were examined. A mixture of mercury vapor and nitrogen gas received especially intensive study. Various ultraviolet sources were investigated for intensity of output at 2537 and 4047 Å, and a number of narrowband spectral filters were tested, particularly in the 2537Å region. An electroacoustic method of scanning a large three-dimensional volume was devised to permit simultaneous presentation of multiple targets in analog fashion at any point within the volume. From results so far realized, it is concluded that a 3-D display system appears feasible. Author

N63-20970 Electro-Optical Systems, Inc., Pasadena, Calif.
THERMAL RADIATION GUIDES FOR POWER TRANSMISSION [Third Quarterly Technical Progress] Report, 1 Oct.-31 Dec., 1962
W. J. Swenson Jan. 15, 1963 54 p 2 refs
(Contract AF 33(657)-8526)
(EOS-3000-Q-3)

Research progress in the state-of-the-art of energy transmission spacecraft by a heretofore unexplored technology is described. The technique involves the transmission of radiant energy through a hollow, reflective tube from a heat source to some other location in a spacecraft without intermediate Carnot cycle limited conversion process. This technique is particularly useful for applications in which a significant portion of the total energy requirement is in the form of thermal energy. Also discussed are: thermodynamic analysis to determine a practical radiation guide size for earth's surface testing with a conventional 5-foot-diameter solar concentrator; descriptions of tooling and process details for radiation guide fabrication, and preliminary testing of guide entrance to determine surface temperature effects; selection of vacuum coatings for radiation guides; and application studies of multiple concentrators with single absorbers. C.L.W.

N63-21072 Duke U., Durham, N.C.
AN ANALOG STUDY OF SYSTEM PROTECTION
T. G. Wilson [1962] 24 p 7 refs
(NASA Grant NsG-152-61)
(NASA CR-50940) OTS: $2.60 ph, $0.92 mf

An initial step toward the simulation of satellite power systems by an analog computer, as a means of studying protection of these power systems, is discussed. Because of the large number of magnetic-core devices in satellite electrical power systems, and because of the important fundamental functions these devices perform, it is considered important that the characteristics of these devices be included in the simulation of such systems. The simulation of a saturable transformer circuit is discussed; it illustrates a technique by which the idealized characteristics of a square-loop core can be included in a circuit simulation. The simulation of the square-loop core is artificial in that the characteristics of the core are fixed, and any changes in an actual core due to stresses will not appear in the simulation. The magnetic-core characteristics included in the simulation are good approximations, and the circuit simulation is accurate. C.L.W.

N63-21151 Bellcomm, Inc., Washington, D.C.
SYSTEMS ENGINEERING
John A. Hornbeck and Julian M. West *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963 p 235-237 (See N63-21126 21-01)

Systems engineering is a management tool created specifically to improve the technical management of large development programs. The functions and responsibilities of systems engineering for the Apollo project are as follows: (1) definition of the overall system requirements (including nominal mission capability); (2) definition of the nominal mission profile; (3) development of the primary Apollo system specification; (4) definition of the overall system test plan; and (5) definition of the overall reliability and quality control program. I.v.L.

N63-21162 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
AN OPTICAL PICK-OFF FOR SERVO-MECHANISMS
A. D. Poole July 1963 11 p
(RAE-TN-SPACE-17)

A description is given of a phototransistor servoposition pickoff which was developed for use on a satellite attitude-control-system simulator. The optical system is simple; no beam splitting mirror and associated lenses are used. Nevertheless it has a maximum sensitivity of 100 mv/min arc and a drift which does not exceed 1/2 minute in 5 hours. Author

N63-21167 Hughes Aircraft Co., Culver City, Calif.
NEED ELECTRIC PROPULSION WAIT FOR THE DEVELOPMENT OF NUCLEAR POWER SOURCES?
R. N. Olson and R. A. Boucher N.Y., Am. Inst. of Aeron. and Astronautics [1963] 26 p Presented at the AIAA Elec. Propulsion Conf., Colorado Springs, Colo., Mar. 11-13, 1963
(NASA Contract NASw-560)
(AIAA Paper 63035) AIAA: $0.50 members, $1.00 nonmembers

Presented herein is a preliminary design of a solar electric test satellite (SETS) system to be used for scientific mission

applications. In addition to having the capability of accomplishing the electric rocket-engine tests, the vehicle can accommodate a scientific package weighing up to 150 pounds. It also provides orientation control and data storage capabilities commensurate with the requirements for scientific experiments such as magnetic and radiation surveys of the upper atmosphere. The system presented uses the Thor-Agena B launch vehicle, utilizes solar cells for primary power, has a three-axis cold-gas attitude control system for the spacecraft proper, and an independent two-axis power-gimbal drive attitude-control system for the scientific package. An on-board high-density magnetic-tape storage system is provided with a data storage capacity in excess of 11,000,000 bits. Author

N63-21174 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
INFORMATION PROCESSING RELEVANT TO MILITARY COMMAND: SURVEY, RECOMMENDATIONS AND BIBLIOGRAPHY Final Report
A. E. Murray and H. R. Leland L. G. Hanscom Field, Bedford, Mass., Electronic Systems Div., Feb. 1963, 154 p
(Contract AF 19(628)-1625)
(CAL-ZF-1724-X-1; ESD-TDR-63-349; Vol. I)

The purpose of this report is to identify and recommend research topics in information processing most likely to yield valuable results. Conclusions are based on a survey of information processing methods relevant to military command and control and, specifically, the subject of: heuristic programing, adaptive networks (e.g., perceptrons), artificial intelligence, pattern recognition, and information storage and retrieval. The survey consists of a comprehensive bibliography relying heavily upon other published collections, a set of original reviews of special topics, such as machine programing, and a discussion ending in recommendations for support of research in six specific subject areas. Author

N63-21226 Thompson Ramo Woolridge Inc., Cleveland, Ohio TAPCO Div.
SUNFLOWER POWER CONVERSION SYSTEM Eighth Quarterly Report, March-May 1962
[1962] 9 p
(NASA Contract NAS5-462)
(ER-4925)

Project progress on the development of the Sunflower power conversion system is reported in the following areas: (1) test-rig design and fabrication, (2) power-conversion systems, (3) solar collectors, (4) boiler-heat storage, (5) turbo-alternator unit, (6) rotational speed control, (7) condenser-subcooler, (8) lithium hydride containment, and (9) materials. P.V.E.

N63-21251 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMP PROGRAMMER
H. D. Moore June 1963 90 p
(NASA TMX-50427; X-632-63-111) OTS: $8.10 ph, $2.90 mf

This report on the IMP programer covers the following: basic relation to payload; circuit function and explanation; and interfaces. J.R.C.

N63-21252 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
STATIC POWER CONVERSION FOR SPACECRAFT AS SPACECRAFT INCREASE IN COMPLEXITY, POWER CONDITIONING BECOMES AN INCREASINGLY IMPORTANT, SOPHISTICATED ASPECT OF SYSTEMS DESIGN
Terry W. Koerner Repr. from Astronautics and Aerospace Eng., May 1963 p 89–92
(NASA Contract NAS7-100)
(NASA CR-51005; JPL-TR-32-426)

The characteristics of static systems for medium power levels and the problems of matching power sources to the load are investigated. Solar panels, thermoelectric couples, and thermionic diodes seem to be very promising power sources. There are several types of regulators that can be used to achieve the desired load regulation. In spite of limitations in response time, nondissipative regulators save power and afford simplification of the design of heat sinks for the regulation equipment in the larger power systems. J.R.C.

07 CHEMISTRY

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N63-20698 Aerospace Medical Center, Brooks AFB, Tex. School of Aerospace Medicine
APPARATUS FOR REPEATED AUTOMATIC EXTRACTION OF POROUS SOLIDS WITH HOT SOLVENT
Dale A. Clark June 1963 8 p 3 refs
(SAM-TDR-63-42)

Apparatus to effect extraction of bulky solids with hot solvents is described. The extraction chamber is heated by boiling solvent vapors, and filled by condensation of those vapors. When filled with solvent, the extraction chamber is emptied automatically by a siphon, as in a conventional Soxholet extractor. A novel condenser provides a large and flexible connection to the extraction chamber, and avoids the use of glass joints and the attendant hazard of breakage. The entire apparatus is useful for repeated automatic extraction of various solid materials with fresh batches of hot solvents, as, for example, in the hot extraction of glass fiber or cellulose paper to be used in chromatography. Author

N63-20711 Argonne National Lab., Ill.
TABLES OF OXYGEN PRESSURES CALCULATED FROM THE HYDROGEN-WATER SYSTEM AND FROM THE DISSOCIATION OF CUPRIC OXIDE
L. M. Atlas and J. B. Moser July 1963 11 p 4 refs
(Contract W-31-109-eng-38)
(ANL-6747)

The dissociation of various mixtures of hydrogen and water vapor and of cupric oxide has been calculated over a wide range of temperatures (from 600° to 1700° C for the H_2-H_2O system, and from 200° to 1000° C for CuO). The resulting partial pressures of oxygen are presented in tabular form. Author

N63-20902 Joint Publications Research Service, Washington, D.C.
HIGH PURITY REFINING OF SILICON TETRACHLORIDE AND TRICHLOROSILANE BY THE RECTIFICATION METHOD
L. A. Niel'son Sept. 6, 1963 9 p 15 refs Transl. into ENGLISH from Izv. Vysshykh Uchebn. Zavadenii, Tsvet. Met. (Dzaudzhikau), No. 2, 1963 p 133–138
(JPRS-20944; OTS-63-31685) OTS: $0.50

Purification of silicon tetrachloride and trichlorosilane by the rectification method is discussed. Basic conditions important to the process of rectification are given, and the forms in which harmful impurities appear in silicon tetrachloride and trichlorosilane are studied. Relative volatilities of impurities in the basic materials to be purified, the number of theoretical column stages, and the value of the phlegma number are the three basic conditions for purification by rectification. C.L.W.

N63-20943 Stauffer Chemical Co., Richmond, Calif. Richmond Research Center
HIGH ENERGY OXIDIZERS Quarterly Technical Summary Report, May 1, 1963-Aug. 1, 1963
K. O. Christe and A. E. Pavlath [Aug. 23, 1963] 11 p 1 ref
(Contract Nonr-4019(00))

In the investigation of chlorinetrifluoride complexes, modification was made on the vacuum line, mostly to make its operation safer. Oleum, fluorosulfonic acid, sulfurtrioxide, and BrF_5 were investigated as possible solvents for the complexes in the NMR studies. The first three gave chemical interactions, while BrF_5 exchanged fluorine with the complexes. Infrared studies were made on ClF_3, AsF_5 (both in solid and gas phase), $KAsF_6$ and $ClF_2{}^+AsF_6{}^-$. Different windows were used and the application of KBr coated with a thin Kel-F layer was found to be the most suitable among the possible solutions. Definite proof was obtained for the presence of the $AsF_6{}^-$ Author

N63-20945 Harshaw Chemical Co., Cleveland, Ohio Central Research Lab.
INVESTIGATION OF THE EXISTENCE OF OXYANIONS OF FLUORINE AND NITROGEN AND THE NITROGEN-FLUORINE CATIONS Quarterly Technical Summary Report, Apr. 28, 1963-July 28, 1963
H. J. Bronaugh and S. I. Khayat Aug. 23, 1963 24 p
(ARPA Order 402; Contract DA-31-124-ARO(D)-76)
(HG-76-2)

Reactivity of nitrogen trifluoride with dilute sodium hydroxide has been demonstrated. Corrosion products derived from monel alter the reaction of nitrogen trifluoride with dilute caustic to produce nitrous oxide. Preliminary data indicate that the reaction of nitrogen trifluoride with dilute caustic may simply be described as:

$$NF_3 + 4NaOH \rightarrow 3NaF + NaNO_2 + 2HOH$$

Author

N63-20955 United States Rubber Co., Naugatuck, Conn.
SYNTHESIS OF REGULATED STRUCTURE POLYPHENYL-ETHER-SILOXANE BLOCK COPOLYMERS Quarterly Progress Report No. 7, Feb. 1, 1963-Apr. 30, 1963
Robert Mac Farlane, Jr. and Eugene S. Yankura [1963] 20 p
(Contract DA-19-020-ORD-5507)

Condensation of 4,4'-dihydroxydiphenylether with dichlorosilanes has resulted in polymers of relatively high molecular weight. A crosslinking reaction occurred simultaneously precluding measurement of the exact degree of polymerization, but monomer purity has been shown to be of critical importance. A quarter-replicate factorial experiment to assess the effects of changes in temperature, reaction time, and reactant concentrations has been completed. Alkaline hydrolysis of 4,4'-dibromodiphenylether results in a mixture of as many as eleven different organic compounds. The experimental results point the way toward elimination of some of these compounds as byproducts in the synthesis of 4,4'-dihydroxydiphenylether. A few trials have shown that it is possible to form 4,4'-dihydroxydiphenylether through intermolecular dehydration of hydroquinone. Author

N63-20958 Brookhaven National Lab., Upton, N.Y.
HIGH-PRESSURE GAMMA LOOP FOR BROOKHAVEN NATIONAL LABORATORY
B. Manowitz and S. Baron (Burns and Roe, Inc.) June 1963 133 p
(Contract AT(30-2)-GEN-16)
(BNL-796-(T-305)) OTS: $2.50

This study was performed in two phases: first, a preliminary design was made of a process system and equipment for the high-pressure gamma loop; and second, a conceptual design was developed for three test cells and a gamma irradiation pool. The object of the proposed high-pressure gamma loop is to provide means of acquiring basic chemical and engineering information necessary for the use of gamma radiation as a standard unit operation. This goal is to be achieved first by a study of radiation-induced polymerization of ethylene monomer to polyethylene, then by a study of other reactions in the same facility. The gamma loop process, facility, instrumentation, and maintenance problems are discussed. The purpose of the three test cells is to provide a facility for small-scale radiation processing and general irradiation experiments. The gamma irradiation pool can be used to store radioactive materials, and to perform standard gamma radiation experiments. The test cells, gamma pool, and related equipment are described. Cost estimates for each activity are also given. E.K.R.

N63-21024 Princeton U., N.J. Frick Chemical Lab.
RELAXATION OF DISULFIDE AND TETRASULFIDE POLYMERS
A. V. Tobolsky, W. J. Mac Knight, and M. Takahashi Sept. 1963 17 p 17 refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-65)

The chemorheology of crosslinked polyethylene disulfide, polyethylene tetrasulfide, and mixtures of these polymers with elemental sulfur, is investigated. It is shown that stress decay in the disulfide polymer occurs by scission of the small quantities of higher polysulfide linkages present in the network. It is also shown that elemental sulfur decreases the chemical relaxation time in crosslinked polyethylene disulfide in a predictable manner. Author

N63-21050 Southern Research Inst., Birmingham, Ala.
A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Annual Summary Report, Feb. 4, 1962 to Apr. 3, 1963
Robert E. Burks, Jr., and Thomas W. Ray Apr. 29, 1963 172 p 52 refs
(NASA Contract NAS8-1510)
(NASA CR-50954; Rept. 26) OTS: $12.50 ph, $5.36 mf

Compounds and polymers with silicon–nitrogen bonds were studied in a search for new materials that are needed to withstand the extreme temperature conditions encountered in space technology. It was found that both thermal and hydrolytic stability are drastically affected by the character of the groups attached to the silicon and nitrogen atoms, and that a high degree of stability to heat and to water can be obtained by selection of the groups. Silicon–nitrogen compounds can be produced with several valuable characteristics such as affinity for metals and ceramics, good thermal and chemical stability, and the ability to undergo endothermic polymerization at high temperatures. These properties have led to encouraging preliminary results with silicon–nitrogen compounds in protective coatings for metals and as components of heat-barrier formulations. Author

08 COMMUNICATIONS

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

N63-20710 RCA Service Co., Patrick AFB, Fla.
SOME FUNDAMENTALS OF INFRARED TECHNOLOGY AND INFRARED DATA REDUCTION ON THE ATLANTIC MISSILE RANGE
Eugene S. Smith May 1963 152 p 15 refs
(Contract AF 08(606)-5300)
(MTC-TDR-63-6)

This report presents a survey of fundamental infrared technology, with primary emphasis on basic radiometric concepts and the reduction of raw infrared data to radiometric quantities. The primary purpose is to provide a training aid and reference document for personnel engaged in and/or training for the reduction of infrared data. Author

N63-20730 Royal Norwegian Council for Scientific and Industrial Research, Blindern
A DOPPLER TRACKING SYSTEM FOR SMALL ROCKET TRAJECTORIES
B. Bjelland (Norweg. Defence Res. Estab.) Mar. 1963 30 p 3 refs
(NSRC Rept. 4)

A tracking system based upon Doppler shift on the modulating frequency of an AM wave is described. Calculations based upon the time-marked Doppler data give the trajectories for well-behaved rockets with a sufficient degree of accuracy. Up to the present, the equipment has been used for tracking of three Nike-Cajun rockets. The method of trajectory calculations is given, and calculation of an actual trajectory is performed. Author

N63-20736 National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
A NOTE ON ANTIPODAL FOCUSSING
James R. Wait Aug. 20, 1963 13 p 7 refs
(NBS-TN-182) GPO: $0.15

Antipodal focusing in very-low-frequency propagation is discussed. A very simple perturbation of the ideal model is considered, and it is assumed that the illumination of the antipodal region is nonuniform. Equations and solutions are given for different components of the electric field under varying conditions. C.L.W.

N63-20737 Hazeltine Technical Development Center, Inc., Indianapolis, Ind.
RADAR SCAN CONVERTER TV MARKER HANDOFF EQUIPMENT Final Engineering Report
R. L. Sorensen May 1, 1962 71 p 1 ref
(Contract FAA/BRD 342)
(Rept. 6087)

The equipment was designed to operate with all existing and future TV display systems presently on order by the Federal Aviation Agency. After factory and environmental testing, the equipment was installed in a simulated TV display environment at the National Aviation Facilities Experimental Center (NAFEC), where a thorough technical and operational evaluation occurred. The Radar Scan Converter TV Marker Handoff Equipment demonstrated exceptional reliability, and to a large extent, meets all specified performance requirements. Author

N63-20739 National Bureau of Standards, Washington, D.C.
MUTUAL INTERFERENCE BETWEEN SURFACE AND SATELLITE COMMUNICATION SYSTEMS [NOVEMBER, 1961]
William J. Hartman and Martin T. Decker Aug. 1, 1963 55 p 10 refs
(NBS-TN-126) GPO: $0.35

Estimates of the mutual interference expected to occur between the ground terminals of space communications systems and surface point-to-point systems are presented in a fashion suitable for engineering applications. These estimates are obtained from recently developed methods for predicting the transmission loss over tropospheric paths in terms of parameters such as geographic separation, elevation angle of the antenna, antenna patterns, and frequency. It is concluded that these systems can share the same frequency assignment under suitable conditions. Author

N63-20741 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
CLASSIFICATION AND EVALUATION OF COHERENT SYNCHRONOUS SAMPLED-DATA TELEMETRY SYSTEMS
Andrew Viterbi Repr. from IRE Trans., v. SET-8, no. 1, Mar. 1962 p 13-22 5 refs
(NASA Contract NASw-6)
(JPL-TR 32-123)

This paper analyzes the various types of continuous wave and pulse modulation for the transmission of sampled data over channels perturbed by white Gaussian noise. Optimal, coherent, synchronous, detection schemes for all the different modulation methods are shown to belong to one of two general classes: linear synchronous detection and correlation detection. The figures of merit, mean-square signal-to-error ratio and bandwidth occupancy are determined for each system and compared. Author

N63-20749 Air Force Systems Command, Griffiss AFB, N.Y. Research and Technology Div.
GROUND-AIR-GROUND DATA TRANSMISSION SYSTEMS TESTS
Adolph J. Uryniak July 1963 26 p 6 refs
(RADC-RAU-TM-63-2)

Tests were conducted to check the feasibility of an air-ground-air narrowband frequency-shift-keying data system utilizing frequency diversity and Doppler correcting techniques. Results of air-ground-air data-transmission tests were described. It can be concluded from the test results that Doppler-correcting narrowband techniques applied to frequency diversity operation in ground-air-ground data transmission is feasible, resulting in reliability and error rates equivalent to ground point-to-point systems operating within similar effective power ranges and antenna gains. Author

N63-20801 Rome Air Development Center, Griffiss AFB, N.Y.
ON THE APPLICATION OF SOME DIGITAL SEQUENCES TO COMMUNICATION Final Report
Jack Keil Wolf Aug. 1963 20 p 4 refs
(RADC-TDR-63-314)

This report discusses the effects of filtering a random binary sequence with certain finite memory, linear, and nonlinear filters. The statistical properties of the filtered sequence are considered. Author

N63-20836 New York U., N.Y. College of Engineering
RELIABILITY IMPROVEMENT OF DIGITAL COMMUNICATION USING REDUNDANCY IN UNCERTAINTY REGION RECEPTION
Ludwik Kurz June 1963 88 p 10 refs
(Contract AF 19(604)-6168)
(Thirteenth Scientific Report; Tech. Rept. 400-77; AFCRL-63-187)

This report considers an efficient method for utilizing the redundancy of transmittable language to improve the reliability of a digital communication system disturbed by additive nonwhite-gaussian noise. The reliability of digital systems using orthogonal and binary digit codes is improved by introducing an uncertainty region at the receiver. This method is an extension and generalization of null-zone reception previously applied to the improvement of binary transmission in the presence of white-gaussian or peak-limited noise. It is shown that, by permitting a small percentage of nulls to be printed, considerable improvement in reliability is achieved. In addition, communication links using orthogonal digit coding afford greater reliability than corresponding links using binary digit coding. Performance results are given for several different codes for the case in which the demodulated gaussian-noise power-density spectrum increases with increasing frequency. Such a noise power-density spectrum acts as a weighting function which confines the generated signals to the available band of frequencies. A geometric interpretation of the results is given in terms of n-dimensional Euclidean space. Author

N63-20908 Royal Norwegian Council for Scientific and Industrial Research, Blindern
TELEMETRY RECEIVING STATION AT THE ANDØYA RANGE
A. Ryen Mar. 1963 16 p
(NSRC Rept. 5)

This report describes the telemetry receiving station being built for the rocket launching range at Andøya. The most pertinent technical data on the subunits are given with reference to figures showing mounting and layout. Author

N63-20963 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SYSTEM CAPABILITIES AND DEVELOPMENT SCHEDULE OF THE DEEP SPACE INSTRUMENTATION FACILITY, 1963-1967
E. Rechtin Mar. 2, 1962 31 p
(NASA Contract NAS7-100)
(NASA CR-51028; JPL-TM-33-83; supersedes JPL-TM-33-27)
OTS: $3.60 ph, $1.13 mf

The capabilities of the Deep Space Instrumentation Facility (DSIF) and the development schedule for 1963-1967 are discussed. At present, the DSIF consists of three Deep Space Stations whose geometry and coverage ability, when combined with a mobile station as an acquisition aid, provides command, telemetry, and positional tracking of the space vehicle. The modifications and improvements indicated for DSIF are being incorporated to assure that these functions remain consistent with spacecraft developments and technological advances. The capabilities and function of the Space Flight Operations Facility are discussed. The reliability of DSIF to foreign governments and operating agencies is considered, and the interface requirements of DSIF for contractor-supplied equipment are presented. M.P.G.

N63-20966 Air Force Cambridge Research Labs., Bedford, Mass. Electronics Research Directorate
A GREGORIAN CORRECTOR FOR SPHERICAL REFLECTORS
F. S. Holt and E. L. Bouche Apr. 1962 17 p 12 refs
(AFCRL-62-163)

The inherent spherical aberration of a spherical reflector antenna is corrected by using an auxiliary Gregorian-reflector feed system that rotates about the center of curvature of the reflector. Tests at both X- and K-band frequencies demonstrated feasibility of the design for wide-angle scanning. Author

N63-21059 Aerospace Medical Div. Wright-Patterson AFB, Ohio Aerospace Medical Research Labs. (6570th)
INFLUENCE OF SELECTED VIBRATIONS UPON SPEECH (RANGE OF 2 CPS-20 CPS AND RANDOM) Final Report, [Nov. 1961-Dec. 1962]
Charles W. Nixon and Henry C. Sommer June 1963 18 p 10 refs
(AMRL-TDR-63-49) OTS: $0.50

Standard speech material read by talkers exposed to low-frequency sinusoidal and random vibration conditions was recorded. This material was evaluated both objectively and subjectively in terms of intelligibility, duration, and quality of speech. In experiment I, seated talkers were subjected to vertical, low-frequency sinusoidal vibration. Frequencies of vibration most detrimental to speech production were 6 cps, 8 cps, and 10 cps when speech material was presented in combination with a masking noise. In experiment II, the sitting talkers were exposed to random vibration that simulated the type of conditions experienced in actual space missions and during high-speed, low-altitude flight. No significant differences in speech production were found due to random vibration (0.5 to 8 cps). Speech communication from the space vehicle may be adequate for environments represented by the conditions of this study. However, when these conditions are exceeded by factors, such as higher G levels and higher noise levels at the microphone, a continuous speech communication capability may not exist. Author

N63-21118 General Mills, Inc., Minneapolis, Minn. Electronics Group
LUNAR TV CAMERA MANIPULATOR, FINAL REPORT
F. Grimm and R. Sullivan [1960] 166 p 13 refs
(NASA Contract-NAS7-100; JPL Contract N-29999; Gen. Mills Proj. 31102)
(NASA CR-50992) OTS: $12.00 ph, $5.18 mf

The design, construction, and testing of a three-motion lunar TV-camera manipulator are discussed. General design philosophy and manipulator description are given along with specifications and component procurement. Manipulator target specifications are given, and attention is also directed toward motors, bearings and lubrication, actuators' seals, and component materials. An analysis is then presented of the different stage sun gears for elevation and pan and tilt drives, after which comes a thermal analysis of the manipulator, concerned with the development of a method for controlling the manipulator temperature within specific limits over a period of 10,000 hours under the extreme conditions of heat and cold encountered on the surface of the moon. C.L.W.

N63-21135 National Aeronautics and Space Administration, Washington, D.C.
APPLICATIONS SATELLITES -- COMMUNICATIONS AND WEATHER
Leonard Jaffee *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963 p 81-93 (See N63-21126 21-01)

Communication satellites, meteorological satellites, and future applications satellites are reviewed. The basic techniques applicable to operational communications satellite systems are: (1) active satellites in low and medium altitude orbits; (2) active satellites in a twenty-four-hour synchronous orbit; and (3) passive reflector satellites. Echo I is a passive reflector satellite which reflects signals but does not amplify

them. Relay and Telstar are experimental satellites of the active intermediate-altitude type. They carry receivers and transmitters for amplifying and retransmitting the received signals and have other electronic equipment for control, telemetry, and power. Syncom I is the first satellite to be placed in a nearly synchronous orbit. Six Tiros meteorological satellites have been launched. The Nimbus satellite is under development; it will have improvements over the Tiros in the following areas: (1) sensors, (2) orientation, (3) coverage, (4) direct local readout, (5) lifetime, and (6) growth potential. The development of meteorological sounding rockets is discussed. The Transit navigation satellite is being investigated as to its suitability for nonmilitary use. Investigations are being conducted as to the possible application of a satellite system to collecting data from automatic unmanned observations stations, particularly in remote or otherwise inaccessible areas. This system will measure and record meteorological data, oceanographic data, magnetic data, etc. I.v.L.

N63-21227 Johns Hopkins U., Baltimore, Md. Carlyle Barton Lab.
SEQUENTIAL DETECTION
David Middleton Sept. 1963 92 p 33 refs
(Contract AF 30(602)-2597)
(RADC-TDR-63-179)

Basic problems involving the binary, sequential detection of signals in noise are discussed in detail. Earlier theory is briefly reviewed and then extended to take into account broader types of models, in particular, those cases where the signal is unknown but the distribution of signal parameters is given or available. New units for specific sequential examples are given. Comparisons are made with the corresponding fixed-sample cases, and it is observed that sequential procedures are, on the average, superior to the fixed-sample detectors (i.e., require smaller input signals, etc., for the same expected performance. Some miscellaneous results for canonical threshold, sequential detectors are also included. Author

N63-21264 Ohio State U. Research Foundation, Columbus Antenna Lab.
AN ULTRA-HIGH FREQUENCY CW REFLECTION MEASURING SYSTEM
S. Mikuteit June 30, 1963 85 p 21 refs
(Contract AF 33(657)-10386)
(Rept. 1566-4)

For the study of echo-area control, a CW radar facility operating at a frequency of 422 Mc, with a variable range from 30 to 103 ft, and the capability to vary the polarization of the transmitting and receiving antennas continuously through 90 deg, has been constructed and calibrated. The system has a dynamic range of 50 db with accurate calibration possible over a range of 80 db if necessary. The minimum, measurable cross section of a target supported on a steel tower at a range of 48 ft is one square wavelength with an accuracy of one db. The null depth is 75 db below a direct connection. Close system stability evaluated over an 8-hour period is ± 1/2 db. The frequency stability is ± 1 kc, resulting in a sufficiently small phase error in the nulling circuit so as to not affect the null depth significantly. Measurements with plates and a hybrid T-bar slot antennafier agree with theoretical values to within the system accuracy. Author

N63-21284 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
CORRELATION BETWEEN VISUAL AND AUDITORY VIGILANCE PERFORMANCE [Final Report]
Louis T. Pope and Don F. Mc Kechnie July 1963 10 p 7 refs
(AMRL-TDR-63-57) OTS: $0.50

This study investigated the relationship between individual performance on a visual vigilance task and an auditory vigilance task. Each of 40 male college subjects participated in two 35-minute test trials, one visual and one auditory. In each 35-minute trial five randomly spaced vigilance signals were presented. Various indices of correlation computed from the data obtained in this study show no relationship between auditory and visual vigilance performance. Author

N63-21289 Naval Ordnance Lab., White Oak, Md.
A PASSIVE TEMPERATURE-TELEMETERING SYSTEM FOR GUN-LAUNCHED MODELS [Research Report, July 1957-May 1960]
E. Pasciutti Sept. 1963 48 p 3 refs
(NOLTR 62-75; Ballistics Res. Rept.-65)

A system gas been developed for telemetering surface temperature data from missile models in free flight along a ballistics range. The model contains a simple RLC circuit. The R portion is a temperature-dependent film resistor. By inductive coupling, the RF energy is transmitted to and from the model as it passes pickup stations along the range. Using a 57-mm powder gun the models were launched at atmospheric conditions to muzzle velocities of between 5,170 and 5,320 fps Author

N63-21350 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-22, VOLUME III, FOR THE PERIOD MAY 1, 1963 TO JUNE 30, 1963. THE DEEP SPACE INSTRUMENTATION FACILITY
July 31, 1963 61 p 5 refs
(NASA Contract NAS7-100)
(NASA CR-51009; JPL-SPS-37-22, Vol. III) OTS: $6.60 ph, $2.03 mf

This report on the Deep Space Instrumentation Facility (DSIF) covers the following equipment and systems: S-band cassegrain diplexer and associated filters; Mark 1 ranging subsystem; modified pattern recorder; remote-control digital positioning system; S-band communication component; experimental low-noise system ground antennas; planetary radar; ranging system development; data signals discrimination; and advanced antenna systems. J.R.C.

09 ELECTRONICS

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

***For related information see:* 06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.**

N63-20700 Atomic Energy of Canda Ltd., Chalk River, Ontario
A 1000-CHANNEL DIGITAL DISCRIMINATOR AND WINDOW SELECTOR CIRCUIT
J. A. Ladd and G. L. Harkley June 1963 32 p 3 refs
(CREL-1123; AECL-1751) AEC of Canada: $1.00

A static discriminator circuit is described which gives an output indicating whether an applied number is larger, or smaller, than a chosen number. Numbers containing three

decimal digits, that is, up to 999, can be dealt with, and these numbers may be applied to the discriminator in binary-coded decimal form. The development of a numerical window selecting circuit using the basic discriminator arrangement is described. The complete window switch assembly is used in a 1000-channel digital stabilizer unit. Author

N63-20717 New York U., N.Y. College of Engineering
SOME NETWORK PROPERTIES OF THE LARGE AREA PN JUNCTION Fourth Scientific Report
G. J. Herskowitz July 1963 38 p 7 refs
(Contract AF 19(628)-379)
(NYU-TR 400-81; AFCRL-63-317)

Reverse-biased large-area PN junctions are used with integrated semiconductor circuits to perform network functions. This paper describes the network properties of such junctions, utilizing an analytic technique which allows the frequency and transient response to be described directly in terms of material, geometry, bias, and termination impedance. Fabrication of the junction and experimental verification of the theory are described. Author

N63-20726 General Electric Co., Milwaukee, Wis.
RESOLUTION CONSIDERATIONS IN PHOTOGRAPHIC-CRT SYSTEMS
C. V. H. Shepard Oct. 22, 1962 13 p 3 refs Presented at the S.P.S.E. Symp. on Photography of Electronic Display, Oct. 13, 1962
(R62XP-4)

The definitions of television resolution and photographic resolution are reviewed, and one of the common methods of measuring cathode-ray tube resolution is discussed. Examination of the TV and photographic definitions indicates that a two-to-one factor exists between TV resolution and conventional photographic resolution. It was found that this same two-to-one factor exists between TV and conventional cathode-ray tube (CRT) resolution. This latter finding is important since, in the past, confusion has existed between limiting resolution parameters in television, photographic, and cathode-ray tube technology. An empirical method for predicting the approximate resolution capabilities of CRT-photographic system is presented. Some of the limitations of this type of resolution pattern are discussed. Author

N63-20731 Air Force Systems Command, Griffiss AFB, N.Y. Research and Technology Div.
ELECTROLESS NICKEL DEPOSITION APPLICATION TO MICROELECTRONICS
Clyde H. Lane June 1963 30 p refs
(RADC-RAS-TM-63-4)

This report describes in-house investigations relative to the application of electroless nickel plating to the fabrication of microelectronic passive components. The results of this work indicate that this method of thin-film deposition is not capable of providing good quality, reproducible resistors at this time. An extensive literature survey on which the laboratory work was based is also included. Author

N63-20767 National Bureau of Standards, Washington, D.C.
SYSTEMS OF ELECTRICAL UNITS
Francis B. Silsbee Repr. from J. Res. Natl. Bur. Std., C. v. 66C, no. 2, Apr.–June 1962 48 p 84 refs
(NBS-Monograph-56) OTS: $0.30

The various systems of measurement, with their respective sets of units, used in the literature on electricity and magnetism are described in detail. Their historical development is summarized. Tables are included for the conversion of equations and numerical values from one system to another. Author

N63-20791 Air Force Systems Command, Griffiss AFB, N.Y. Electronic Warfare Lab.
SIMPLIFIED DETERMINATION OF DIELECTRIC CONSTANTS APPLICABLE TO MICROWAVE ABSORBERS
Roger Ringlund, Bruno Beek, and Karl Kirk June 1963 23 p 6 refs
(RADC-TDR-63-241)

A process has been studied which allows the rapid testing of selected dielectric materials having low loss. This process was evolved by considering the general functions which provide dielectric constant (ϵ') and loss tangent ($\tan \delta$), and by making certain acceptable assumptions. The method of measurement required the direct determination of λ_M, the wavelength existing in the material under test. For selected materials, the validity of this measurement is exemplified and discussed. Author

N63-20792 Diamond Ordnance Fuze Labs., Washington, D.C.
VERY BROADBAND COAXIAL-TO-RIDGE WAVEGUIDE TRANSITIONS
Paul J. Muenzer Aug. 16, 1963 18 p 2 refs
(TR-1157)

A very broadband coaxial-to-ridge waveguide transition has been designed for use in antennas and ridge-waveguide components. A description of the transition-design procedures and performance data are presented. The transition was initially designed to operate in the frequency range from 0.8 to 2.3 Gc with a voltage standing wave ratio (VSWR) of less than 1.8. The results indicate that the design performs better than the specified requirements. When used as a feed for an electromagnetic horn, the VSWR was less than 1.7 from 0.85 to 2.7 Gc, and less than 2.0 in the frequency ranges of 0.6 to 3.1 Gc and 4.1 to 4.9 Gc. Author

N63-20795 Ohio State U., Columbus, Ohio. Antenna Lab.
APPLICATION OF ELECTROMAGNETIC ABSORBING MATERIALS AS INTERFERENCE REDUCTION TECHNIQUES
Leon Peters, Jr. and R. C. Rudduck Griffiss AFB, N.Y., Electromagnetic Vulnerability Lab., Aug. 1963 13 p 2 refs
(Contract AF 30(602)-2711)
(RADC-TDR-63-273)

The radiation pattern of a thin-walled pyramidal horn is analyzed by the geometrical theory of diffraction. The calculated pattern agrees well with measured results over the entire pattern, including backlobes. Measured patterns of thick-walled horns are presented and the significance of wall thickness is noted. The importance of edge structure for RFI reduction is discussed. Author

N63-20799 Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Board
RADIO RESEARCH 1962 [Report]
J. A. Ratcliffe London, Jan. 1963 34 p
Available from British Inform. Services, 45 Rockefeller Plaza, N.Y. HMSO: 3s

Radio research is reported in the following areas: (1) the lowest part of the ionosphere, (2) above the F layer, (3) antennas or small probes on space vehicles in the ionosphere, (4) long-distance ionospheric propagation, (5) cosmic rays, (6) ionospheric irregularities and movements, (7) the equatorial anomaly in the ionosphere, (8) the location of radio noise sources, and (9) development of a new ionosonde. P.V.E.

N63-20833 Harry Diamond Labs., Washington, D.C.
SMALL SIGNAL PROPERTIES OF TWO MINIATURE MICROWAVE DIODES
William L. Soper July 8, 1963 68 p 38 refs
(TR-1140)

The properties of two types of recently introduced, miniature, microwave diodes are investigated. Three type 1N830 diodes and two type 1N833 diodes are evaluated for low-level video-detector applications. The diodes are compared with respect to their static characteristics, their RF impedances, and their tangential signal sensitivities. High-frequency equivalent circuits are derived and compared to the experimental results obtained for each sample. Author

N63-20855 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PHOTOEMISSIVE DETECTORS FOR LABORATORY AND SPACE RESEARCH
Charles B. Childs *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14–15, 1960 p 59–74 (See N63-20851 21-23)

This report constitutes the findings of an investigation of photomultipliers produced by DuMont, RCA, and EMI of England. The noise of the DuMont tubes prevented their use. RCA produced a somewhat better tube than DuMont but their product proved unusable because 10^5 gain at 1400 volts did not meet photometer requirements. Since DuMont and RCA tubes failed to meet photometer requirements, EMI was contacted. The remainder of the report relates the merits of the EMI product as compared with the RCA and DuMont tubes. Author

N63-20856 Naval Ordnance Lab., Corona, Calif.
SOLAR BLIND PHOTODIODES HAVING MAXIMUM SENSITIVITY IN THE MIDDLE ULTRAVIOLET
George G. Kretschmar *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14–15, 1960 p 75–86 3 refs (See N63-20851 21-23)
(NASA Order S-7423-G)

A method is described for the production of photoelectric diodes having maximum sensitivity in the near ultraviolet. These photodiodes are essentially solar blind. The cathodes consist of thin layers of rubidium telluride formed on nickel substrates during the evacuation of the tubes. These cathodes have been shown to have high-quantum efficiency at about 2200 to 2600 A, with little or no sensitivity at wavelengths greater than 3400 A. Author

N63-20858 Radio Corp. of America, Princeton, N.J.
PHOTOMULTIPLIERS SENSITIVE DOWN TO 1100 ANGSTROMS
A. H. Sommer *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C. July 14–15, 1960 p 95–99 2 refs (See N63-20851 21-23)

An experimental 14-stage multiplier tube with an alkali telluride photocathode is described. The following aspects are discussed: use of CaF_2 and LiF windows; advantages and disadvantages of Cs_2Te, Rb_2Te, and K_2Te; opaque versus semitransparent photocathodes; and gain and dark current. Results were reported on a tube which had to fulfill the following requirements: sensitivity down to the LiF or CaF_2 range; optimum solar blindness; high quantum efficiency; semitransparent photocathode; minimum gain of 10^6; and low dark current. To meet these requirements, the main effort was concentrated on developing techniques for sealing fluoride windows to glass and on the activation process of suitable cathodes. Author

N63-20895 California U., Livermore Lawrence Radiation Lab.
A LOW INTERRUPTING CAPACITY FUSE FOR ENERGY-STORAGE CAPACITOR BANKS
Robert J. Thomas May 8, 1963 40 p Presented at the Fourth Symp. on Eng. Aspects of Magnetohydrodynamics, Berkeley Apr. 1963
(Contract W-7405-eng-48)
(UCRL-7191) OTS: $1.00

An indicating fuse of relatively low interrupting capacity has been developed for fault protection of energy-storage capacitor banks. It is intended for location in a separate charging circuit, thereby obviating the more difficult interruption and coordination requirements of fuses located in the energy-discharge circuit. It is particularly applicable to, but not restricted to, banks composed of individually charged and switched capacitors. Author

N63-20901 RAND Corp., Santa Monica, Calif.
A NEW METHOD OF FREQUENCY SYNTHESIS
C. Lindholm and S. Johnson July 1963 39 p 2 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3756-PR)

A number representation scheme has been discovered which can be applied to frequency synthesizers such as those used in communication transmitters and receivers. The scheme permits the construction of a very large number of frequencies from a much smaller set of fundamental (basis) frequencies. This approach may be applied to a variety of different communication requirements, such as airborne or portable equipment where weight or volume limitations are important, and to wideband (spread spectrum) techniques. In the latter field, the basis frequencies may be generated by other synthesis techniques, but mixed by the methods shown here. A distinction between nonlinear mixers and linear modulators for summing frequencies is described, and it is noted that for ease of separation of spurious products, the linear modulator appears more desirable. Finally, the mathematical basis for the number representation scheme is described, and tables useful to the design engineer are included. Author

N63-20918 Kiruna Geophysical Observatory (Sweden)
VERY LOW FREQUENCY RADIO WAVE PROPAGATION AT HIGH-LATITUDES Scientific Report No. 1
Alv Egeland and Willi Riedler June 25, 1963 25 p 14 refs
(Contract AF 61(052)-678)
(AFCRL-63-856)

A gradual change from a daytime maximum in 16 kc signal strength during 1959 and 1960 to a nighttime maximum during 1962 and 1963 has been observed. The day to night variation of the 16 kc signal strength is discussed in relation to a mode theory, for a first-order approximation. An average increase in apparent reflection height from 1959 to 1963 of the order of 5 to 10 km explains the observations. Author

N63-20961 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
DESIGN OF BROADBAND TRANSMISSION LINE EQUALIZERS
George I. Zysman June 5, 1962 51 p 9 refs
(Contract AF 30(602)-2213)
(PIBMRI-1018-62; RADC-TDR-62-234)

This report is concerned with the design of microwave broadband equalizers consisting of cascaded transmission lines, to work between a resistive generator and an arbitrary load. The design criterion is optimized-gain bandwidth performance. Such performance is obtained by prescribing a flat power-transfer characteristic, subject to the inherent restrictions of the load. The equalizer is then synthesized by the use of an approximation method devised by Carlin. Problems

considered here are (1) distributed parameter load and (2) lumped parameter load associated with microwave broadbanding of a tunnel diode amplifier. Author

N63-20989 Watkins-Johnson Co., Palo Alto, Calif.
WIDE BAND ELECTRONICALLY TUNABLE FILTERS Technical Note No. 2, 1 Oct. 1962 to 31 Jan. 1963
A. W. Shaw Feb. 1963 28 p
(Contract AF 30(602)-2625)
(W-J 63-609R10; RADC-TDR-63-137)

Methods of improving the passband distortion in X-band and K_u-band yttrium-iron-garnet (YIG) filters are outlined. Tests at both X-band and K_u-band are described. A wedge-loaded coaxial line for use in nonreciprocal YIG filters at L-, S-, and C-band is discussed and results on directivity at S-band are given. This type of line should work well in bandpass filters at L- and S-band, but at C-band there are problems with passband distortion. Work on a bandreject filter at X-band is presented along with plans for extension of the same technique to L-, S-, and C-band. Author

N63-21005 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR CELLS AND THE APPLICATIONS ENGINEER
William R. Cherry Repr. from Astron. Aerospace Eng., May 1963 p 54–57 10 refs
(NASA RP-9)

A description is presented of solar-cell characteristics and performance, and of the greater skill and efficiency with which applications engineers can treat solar-cell systems. Within the past decade, solar cells have advanced from primitive ones of about 4% to 5% efficiency to refined ones, incorporating antireflecting and heat-dissipative coatings and having efficiency as high as 14% to 14.5%. Solar cells will be used as the primary power source on spacecraft with missions of three months or more duration for at least the next five years. The cells are still very expensive and offer array (less than 7) and system (less than 3) w-to-lb ratios for oriented and nonoriented systems. P.V.E.

N63-21008 Texas Instruments, Inc., Dallas Mfg. Technology Lab.
SILICON SEMICONDUCTOR NETWORKS MANUFACTURING METHODS Interim Technical Engineering Report, Jan. 1-Mar. 31, 1962
J. W. Lathrop and W. C. Brower Nov. 1962 31 p
(Contract AF 33(600)-42210)
(ASD-IR-7-865(VI))

Techniques have been developed for evaluation of all diffusion parameters. All machines for the pilot line are either completed, being constructed or modified, or in advanced design stage. The philosophy guiding creation of these machines is that all possible operations will be performed on the functional electronic blocks while they are still in slice form. These operations include cleaning, polishing, photo-resist applications, etching, diffusion, and application of evaporated leads and contacts. Considerable progress has been made toward perfecting a welded package. Author

N63-21016 Watkins-Johnson Co., Palo Alto, Calif.
WIDE BAND ELECTRONICALLY TUNABLE FILTERS Technical Note No. 3, 1 Feb. to 31 May 1963
A. W. Shaw May 1963 21 p
(Contract AF 30(602)-2625)
(W-J 63-609R15; RADC-TDR-63-327)

Progress on yttrium-iron-garnet (YIG) nonreciprocal filters at 1 to 18 gc is discussed. Four-stage, bandpass filters at X- and K_u-bands are nearing completion. Two-stage, bandpass filters at L-, S- and C-bands are in various stages of completion. A three-stage band-reject filter at X-band is nearing completion, while band-reject filters at L-, S-, and C-bands are in various stages of completion. A power supply to sweep the filters has been designed and constructed. Author

N63-21046 Utah State U., Logan Antennas and Propagation Lab.
A LOG PERIODIC MONOPOLE ANTENNA IN A DIELECTRIC FILLED CAVITY Interim Report No. 2
Richard L. Whale and Clayton Clark June 30, 1963 70 p 11 refs
(NASA Grant NsG 221-62)
(NASA CR-51097) OTS: $6.60 ph, $2.30 mf

The input impedance characteristics and radiation patterns of a log-periodic monopole antenna when flush mounted in a dielectric filled cavity are investigated. The H-plane radiation field equation for a log-periodic monopole antenna over an air-filled cavity is derived and solved by approximation. The predicted main lobe direction and shape was compared with experimental air cavity pattern measurements. The close agreement obtained verifies that: (1) the active region of the antenna can be determined by estimating the base impedance of each element at the operating frequency, thus determining the contribution of each element to the operating frequency; (2) the center bar of the antenna acts as a transmission line; and (3) the velocity of the voltage wave on the center bar is approximately uniform over the active region. Radiation pattern and impedance measurements were also made on models in which relative dielectric constants were 2.25 and 4.00 at frequencies between 2.0 and 4.0 gigacycles. The equation for the dielectric filled cavity was set up and the radiation equations are being programed for computer calculation. M.P.G.

N63-21048 Duke U., Durham, N.C.
STATIC DC TO SINUSOIDAL AC CONVERSION
T. G. Wilson [1962] 18 p 4 refs
(NASA Grant NsG-152-61)
(NASA CR-50938) OTS: $1.60 ph, $0.80 mf

A static dc to sinusoidal ac conversion circuit was built and tested, without a filter, with both purely resistive and slightly inductive loads only. Operation was stable for medium loads, but showed irregular behavior with large loads. P.V.E.

N63-21053 Texas U., Austin Electrical Engineering Research Lab.
DESIGN, FABRICATION AND INSTALLATION OF A 16-FOOT PARABOLIC REFLECTOR ANTENNA Final Report
Archie W. Straiton June 30, 1963 13 p
(NASA Contract NASr-87)
(NASA CR-50754) OTS: $1.60 ph, $0.80 mf

This contract provided for the design, fabrication, and installation of a 16-foot parabolic reflector antenna. The antenna was tested at 70 kMc and was found to be in general agreement with the specifications which were set out in the contract. Author

N63-21061 Lincoln Lab., Mass. Inst. of Tech., Lexington
A STUDY OF INTERMODULATION INTERFERENCE IN A MULTITRANSMITTER-MULTIRECEIVER ENVIRONMENT
Alfred I. Grayzel Nov. 26, 1962 28 p refs
(NASA Contract NAS9-105)
(NASA CR-50916; AP-21) OTS: $2.60 ph, $1.04 mf

This report explains how the level of transmitter-generated intermodulation in terms of various parameters of multitransmitter–multireceiver systems is estimated. Methods are offered

for minimizing or eliminating interference by frequency choice and by filtering. Where doubt exists as to interference level, crucial measurements are suggested. Author

N63-21116 Michigan U., Ann Arbor Electron Physics Lab.
INVESTIGATION OF LARGE-SIGNAL TRAVELING-WAVE TUBES Quarterly Progress Report No. 2, Oct. 1, 1962-Dec. 31, 1962
G. T. Konrad, J. E. Rowe et al Griffiss AFB, N.Y., Techniques Lab., July 1963 43 p refs
(Contract AF 30(602)-2834)
(RADC-TDR-63-108)

A digital computer program is used to obtain solutions to a two-dimensional nonlinear analysis for large-signal traveling-wave devices. Velocity distributions near saturation are shown for a number of cases. Derivation of the equations for a density function method to be used in the solution of large-signal phenomena in multistream microwave devices is given. Experimental phase-shift data obtained on a velocity tapered TWA is presented. The characteristics of a different transducer to be used on the tube tapered by 70 percent are shown. Techniques for the brazing process to be used in the depressed potential collector are described. The method worked out is shown to be quite satisfactory from an electrical as well as a mechanical standpoint. The present status of digital computer programs for solid- and hollow-beam guns is described. Future modifications to make the programs more versatile are discussed. Noise figure data for the Crestatron are given. A minimum noise figure of approximately 19 db has been observed for typical values of gain to be encountered in a Crestatron. Author

N63-21165 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY First Quarterly Progress Reports, July 1, 1962-Sept. 30, 1962
Howard Moss et al [1962] 130 p
(Contract DA-36-039-SC-86730)

Progress was made in the following general areas: (1) material preparation and photo-resist processes and facilities were improved; (2) a new package was designed to improve both the in-process ruggedness and the environmental capabilities of the device. Prototypes were evaluated and tooling was placed; (3) feasibility work was completed on processes designed to improve the collector and emitter-base contacts; (4) inspection and process control techniques were improved; (5) feasibility of planar processes was established, and the decisions were made to build the planar device using the above-mentioned improved contacts and the new package. The objective is to optimize the existing mesa device, while simultaneously perfecting an interchangeable planar device. Author

N63-21166 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Quarterly Progress Report No. 2, Oct. 1, 1962-Dec. 31, 1962
Howard Moss et al [1962] 99 p
(Contract DA-039-SC-86730)

Progress was made as follows: (1) Continued improvement was made in material preparation area, particularly in the area of slice cleaning. (2) The new package was tooled and modified slightly. A machine for accurately assembling the slug and header was built and evaluated satisfactorily. (3) Work continued on improved contacts. A gold-alloy collector braze and a cold-bonded aluminum emitter and base contact were adopted for the planar device. (4) Several pieces of equipment were built to facilitate process control. (5) Planar diffusion processes were optimized in production facilities. Author

N63-21176 Westinghouse Electric Corp., Philadelphia, Pa.
PRODUCTION ENGINEERING MEASURE, TYPE 2N1016B SILICON ALLOY TRANSISTOR Quarterly Progress Report No. 3, Covering Period through Mar. 31, 1963
S. Chinowsky, T. Csakvari, E. G. Fatzer, J. R. Forys, and R. W. France et al [1963] 75 p
(Contract DA-36-039-SC-86743)

Progress on several phases of the process improvement program leading to completion in terms of revised process specifications is described. Also, continued development in other process improvement areas is described. Considerable data and preliminary analysis of the step-stress program results are given. Author

N63-21192 Clevite Corp., Cleveland, Ohio
PRODUCTION ENGINEERING MEASURE FOR THE IMPROVEMENT OF GERMANIUM ALLOY POWER TRANSISTORS Third Quarterly Progress Report, 31 Oct. 1962-31 Jan. 1963
George Wallis [1963] 107 p
(Contract DA-36-039-SC-86724)

Life test results on jet-rinsed transistors are discussed. Initial and life test results are presented for transistors on which surface passivation by oxidation was attempted. The welding procedure was investigated, and it was determined that erratic results were obtained due to insufficient control over the dessicant which is dispensed during this operation. Steps have been taken to correct this situation. A new method has been proved out for introducing helium into the welded transistor for purposes of leak detection. Results are given for approximately 1,000 transistors with ten-mil-thick collectors versus about 750 transistors with our standard five-mil collector. A homogeneous lot of 3,000 transistors was manufactured and put on 90°, 125°, and 145° C storage test, elevated temperature cutoff test and step-stress test. Results are presented and failure modes are discussed. Author

N63-21193 Texas Instruments Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Quarterly Progress Report No. 2, Aug. 1, 1962-Oct. 31, 1962
James R. Reese, Stratt Georgoulis, Jim Nygaard, Albert T. Nemecek, and Sam L. Carrell [1962] 66 p
(Contract DA-36-039-SC-86730)

Discussed are engineering measures necessary for attainment of a maximum failure rate of 0.01% and 0.001% per 1000 hours at a 90% confidence level for a series of germanium epitaxial mesa transistors, and silicon nonplanar epitaxial transistors. Progress in engineering activity for the germanium transistors was reported in the following areas: epitaxial growth control, surface preparation of substrate for growth, epitaxial continuity control, diffusion control to eliminate resistivity product problem, encapsulation technique, evaporation control, mesa and dice cutting, and stripe alloying. Progress in engineering activity for the silicon transistors was reported in the following areas: epitaxial material, cleanliness prior to high-temperature operations, control of diffusion, photomasking and etching, header improvement, lead attachment, and contact materials. E.K.R.

N63-21195 Clevite Corp., Waltham, Mass.
PRODUCTION ENGINEERING MEASURE FOR THE IMPROVEMENT OF GERMANIUM ALLOY POWER TRANSISTORS Fourth Quarterly Progress Report, 31 Jan. 1963-30 Apr. 1963
John I. Kelly [1963] 94 p
(Contract DA-36-039-SC-86724)

Life test results are discussed for transistors on which surface passivation by oxidation was attempted. Results are presented for Humidity Testing of precapped units. Results on the use of a molecular sieve and calcium sulphate are discussed. Methods of improving soldering of the new clip are outlined. The program involving 10 mil collectors is presented. The program on a new tray, clip blower, and hand tester is presented. A helium leak detector is now in operation on a 100% basis. Results on reliability measurements of transistors are presented. Author

N63-21199 General Electric Co., Syracuse, N.Y.
PRODUCTION ENGINEERING MEASURE. SILICON PLANAR EPITAXIAL TRANSISTOR TYPE 2N2193. SILICON GROWN DIFFUSED TRANSISTOR TYPE 2N336 Fourth Quarterly Report, Jan. 31-Apr. 30, 1963
P. W. Olski [1963] 73 p
(Contract DA-36-039-SC-86727)

Progress in the development of silicon planar epitaxial and silicon-grown diffused transistors is reported. Areas of work in the development of the silicon planar epitaxial transistor include: (1) contact evaporation and alloying, (2) collector contact to header, (3) interconnections—improving bonding processes, (4) reliability measurement, and (5) inspection and quality-control plans. Results of experimentation and evaluation of the silicon-grown diffused transistor, along with characteristic distribution curves for the transistor, are presented. P.V.E.

N63-21200 General Electric Co., Syracuse, N.Y.
PRODUCTION ENGINEERING MEASURE. SILICON PLANAR EPITAXIAL TRANSISTOR TYPE 2N2193. SILICON GROWN DIFFUSED TRANSISTOR TYPE 2N336 Third Quarterly Report, Oct. 31, 1962-Jan. 31, 1963
F. J. Potter [1963] 67 p
(Contract DA-36-039-SC-86727)

Progress in the development of silicon planar epitaxial and silicon-grown diffused transistors is reported. Areas of work in the development of the silicon planar epitaxial transistor include: (1) improved light collimation during KPR exposure, (2) contact evaporation and alloying, (3) boron diffusion, (4) phosphorus diffusion, (5) collector contact to the header, (6) interconnections—improving bonding processes, (7) reliability measurements, and (8) inspection and quality-control plans. A description of automatic passivation equipment used in production, experimentation, and evaluation results, and characteristic distribution curves of the silicon-grown diffused transitors are presented. P.V.E.

N63-21216 Boeing Co., Seattle, Washington Aero-Space Div.
ANALYTICAL METHODS FOR PREDICTING TRANSIENT NUCLEAR RADIATION EFFECTS ON ELECTRONIC CIRCUITS AND DEVICES
G. L. Keister Kirtland AFB, N. Mex., Air Force Weapons Lab., July 1963 62 p 56 refs
(Contract AF 29(601)-5238)
(RTD TDR-63-3007)

A method for predicting the responses of electronic circuits and systems to the radiation pulse of a nuclear detonation has been developed and demonstrated. This method employs generalized radiation equivalent circuits for each component of the circuit or system. The component equivalent circuits are combined for circuit and system prediction using standard electrical engineering methods of circuit analysis, and the resulting circuit equations are solved on either an analog or digital computer. Four component equivalent circuits and their associated constants and circuit equations are presented for use in analyzing the behavior of these circuits in a generalized radiation environment. This method has been applied to the prediction of the response of four guidance and control circuits for flash X-ray, linac, and nuclear weapon environments, and of a simple servoloop for the flash X-ray and linac environments. The results of the prediction were compared with experimental results in the same environments. Within the scope of present knowledge of the component and environment variations, this comparison has resulted in excellent agreement for both the real-time pulse shapes and the signal amplitude for radiation rates up to 10^9 r/sec. Author

N63-21222 Technical U., Copenhagen (Denmark) Lab. of Electromagnetic Theory
A SURVEY OF THE LITERATURE ON MIXED PATH PROPAGATION Technical Note No. 1
Tove Larsen Mar. 1962 25 p 80 refs
(Contract AF 61(052)-503)
(AFCRL-62-545; S75-R25)

The report contains a survey of papers dealing with the propagation of radio waves over a ground consisting of areas of various electric constants. The survey is divided into two parts, the first one describing the more or less semiempirical solutions which have been proposed, the latter describing the more rigorous mathematical methods of calculations. Among these is the compensation theorem method, which seems to be the most adequate of the mathematical methods, and of use in all mixed-path problems. Author

N63-21224 Ohio State U. Research Foundation, Columbus, Antenna Lab.
RESEARCH ON THE APPLICATION OF THE LUNEBERG LENS TO ECM ANTENNA SYSTEMS Interim Engineering Report, Mar. 1, 1962-May 31, 1962
R. C. Rudduck, C. E. Ryan, C. H. Davis, and C. H. Walter June 1, 1962 15 p 3 refs
(Contract AF 33(657)-7829)
(Rept.-1394-4)

A geodesic lens model has been tested. The lens is designed to focus on the conical portion of the lens in order to give better results with flush-mounted feeds. Calculations are described which indicate that scanning of the beam in the vertical plane is practical. Author

N63-21225 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
A THEORY FOR BROADBAND TUNNEL DIODE AMPLIFIERS
Lowell I. Smilen Apr. 20, 1963 129 p 24 refs
(Contract AF 30(602)-2213)
(RADC-TDR-62-191; PIBMRI-998-62)

This thesis deals with the determination of the broadband limitations imposed on transducers incorporating tunnel diodes. The gain-bandwidth restrictions arise because of the parasitic elements associated with the negative resistance of the equivalent network model of the diode. These restrictions are derived for the most general amplifier obtained by embedding a single tunnel diode in a passive, lossless environment. It is shown that the optimum nonreciprocal amplifier can yield 6 db more transducer power gain than the optimum reciprocal one. This thesis also deals with the development of synthesis

procedures for any physically realizable transducer power-gain function. The synthesis procedures provide for the realization of Butterworth and Tchebycheff responses of any order which are capable of achieving the optimum gain-bandwidth performance, as the order of the response is increased (and the ripple decreased, in the case of the Tchebycheff response). Thus for a specified set of tunnel diodes, the optimum equalizers may be designed to realize their gain-bandwidth potential. Author

N63-21230 General Atronics Corp., West Conshohocken, Pa.
PULSE STRUCTURES FOR ENHANCED ACCURACY Final Report
T. L. Williams June 1963 156 p 10 refs
(Contract AF 30(602)-2417)
(RADC-TDR-63-306; Rept. 1195-242-32)

This report presents detailed theoretical and experimental data regarding the accuracy of the simultaneous estimates of range and Doppler, and the utility of the tangent-approximating manifold (TAM) estimator. The measurements were made with a target simulator (capable of representing two targets plus noise and clutter) and a TAM estimator. The experimental data agree with the theory except for a few explainable cases. The results definitely prove the advantage of enhanced accuracy waveforms which have no linear frequency modulation. A single TAM estimator is useful only over a region of Doppler and range about equal to the resolution of the radar pulse. For the measurement of Doppler and range, it offers no obvious advantage over a matched filter bank plus an interpolator. But the TAM estimator does provide a measure of multiplicity which is not available from conventional estimators. The multiplicity estimate is useful to indicate the presence of two targets when the two targets are both in the same range and Doppler bin. For some applications the multiplicity estimate may be desired, in which case the TAM estimator will be more useful than a conventional estimator. Author

N63-21238 Radio Corp. of America, Princeton, N.J.
CESIUM VAPOR CATHODE STUDY Final Report, June 15, 1962-July 14, 1963
A. L. Eichenbaum, F. H. Norman, P. T. Smith, and H. Sobol
July 14, 1963 37 p 7 refs
(Contract AF 30(602)-2767)
(RADC-TDR-63-345)

Experimental and theoretical studies were performed on cesium-plasma cathodes and guns designed to yield beam-current densities of 100/cm^2 or higher. In the common-emitter type of plasma cathode, ions and electrons are emitted at the inner surface of a hollow tantalum cylinder. The electrons are emitted thermionically and ions are obtained by contact ionization of cesium. Electrons are extracted from such a hollow cathode through an exit aperture. In the separate-emitter type of plasma cathode, ions are produced by contact ionization of cesium at a surface opposite to an L-cathode electron emitter. Electrons are converged and pass through an aperture in the ion emitter. Lower-temperature operation of the emitters is achieved by optimum selection of each emitter. A newly developed silver chloride seal proved convenient for rapid opening and resealing of tubes containing cesium vapor. The minimum temperature at which a high-alumina body must be kept to maintain a high surface resistivity in the presence of cesium vapor was studied and found to be about 100° C. A program to study RF and d.c. voltage breakdown in the presence of cesium films and vapor was initiated. Theoretical studies were carried out to determine the conditions for plasma stability in the region where the plasma is synthesized, and also in the beam-extraction region just outside the exit aperture. It was found that it is possible, under usual conditions, to obtain a stable plasma in both of these regions. Author

N63-21239 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
STUDY OF FAILURE MECHANISMS IN HIGH POWER RADIO FREQUENCY GENERATING DEVICES Final Report [Jan. 1-Dec. 31, 1962]
M. Friedman Axler, R. A. Hein, and T. G. Polanyi Dec. 30, 1962 130 p 6 refs
(Contract AF 30(602)-2595)
(RADC-TDR-63-189; TR 63-254.4)

Investigations were undertaken to determine the causes of failures in gridded power traveling-wave tubes. The gas ambient of two types of operating tubes and of individual tube subassemblies and components are examined with an omegatron mass spectrometer permanently attached to the unit under test. Background gas ambients in envelopes containing only omegatrons are used as controls and are presented. Electrical test parameters of the traveling-wave tube in relation to its gas ambient are presented, and correlations are made with cathode activity decrease and power output decrease as functions of integrated, partial gas pressures in the operating tube. Contributions made by various processed tube components to the gas ambient of the operating vacuum tube are presented and discussed. The gas content that can be released upon heating several materials of interest is determined by a hot extraction method used in conjunction with a commercial mass spectrometer. Results are presented and discussed. Author

N63-21243 Polytechnic Inst. of Brooklyn, N.Y. Microwave Res. Inst.
CALCULATION OF DISTRIBUTED CONSTANTS OF MULTIWIRE LINES
Akio Matsumoto May 10, 1962 41 p 7 refs
(Contract AF 30(602)-2213)
(PIBMRI-991-62; RADC-TDR-62-296)

This report treats the method of calculating the distributed constants of a line consisting of three conductors; one is the shield, and the other two are inner conductors. A short table is given for the distributed capacitances and inductances of the line in which one of the two inner conductors is coaxial with the shield, and the other off-axial. This configuration can easily be transformed into other configurations with both inner conductors off-axial with the shield. Some approximate formulae are given to allow a faster estimation of the distributed constants of the line. Comments are made on slot-coupled lines and symmetrical two-wire lines. Author

N63-21256 Aeronautical Research Labs., Melbourne (Australia)
INCREASING THE STABILITY OF A SERIES TUBE REGULATED D.C. POWER SUPPLY EMPLOYING A CASCODE SHUNT AMPLIFIER
R. C. Tobin Dec. 1962 18 p 4 refs
(ARL/1-62)

The main purpose of this note is to describe a simple method by which the stabilization ratio and the output impedance (and therefore the stability of the output voltage) of a series-tube-regulated d-c power supply employing a cascode shunt amplifier, can be significantly improved. This increase in stability is achieved by introducing an input compensation signal voltage at the upper grid of the cascode amplifier. In order to present the theory of the method, the principles of operation of the series-tube regulator circuit with input compensation are reviewed. Author

N63-21262 Varian Associates, Palo Alto, Calif.
HIGH POWER R-F WINDOW STUDY PROGRAM Quarterly Technical Note No. 4, Apr. 1-June 30, 1963
Floyd Johnson July 1963 52 p 12 refs
(Contract AF 30(602)-2844)
(Varian Rept. 304-4Q; RADC-TDR-63-349)

The objective of specifying and deriving the elements of an equation for the analytical solution of waveguide window-design problems has been met. By programing this equation and using dimension parameters as variables, a computer can be used to greatly speed up window design. Two types of windows have been programed and successfully computed. The block ceramic window, using dual-symmetric, inductive-iris broadbanding techniques, has been computed for several cases, and the results have been shown to be almost exact when compared to measured data. The thin-disc type of window, either single or double disc dielectric-cooled, has also been programed. Comparisons of computed and measured results also show a very close correlation, but it is not so exact as for the block window. Author

N63-21293 Harshaw Chemical Co., Cleveland, Ohio. Solid State Res. Lab.
NON-EQUILIBRIUM SURFACE POTENTIAL CALCULATIONS FOR SEMICONDUCTORS Topical Report
J. D. Nixon and O. G. Fritz Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Aug. 1963 19 p 3 refs
(Contract AF 33(657)-7916)

The surface space-charge is computed for the case of non-equilibrium concentrations. This space-charge is equated to the charge in surface recombination centers, and by a graphical method, the surface potential is determined as a function of minority-carrier excess concentrations. The model is tentatively applied to a surface barrier device, namely, the cadmium-sulfide photovoltaic cell. Application to the composite photovoltaic cell is also given. Author

N63-21294 General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.
RESEARCH AND DEVELOPMENT PROGRAM OF THERMIONIC CONVERSION OF HEAT TO ELECTRICITY Technical Summary Report
V. C. Wilson et al Aug. 30, 1963 96 p 12 refs
(Contract NObs-88578; ARPA 219)
(GEST-2021)

The following progress is reported: (1) Two emitter-collector spacing configurations have successfully completed component testing. (2) An assembly to allow the testing of a number of concepts of possible cesium passages from one thermionic diode to the next in a series arrangement has been designed and fabricated. (3) An electron beam furnace for the study of UO_2 refractory metals interactions at temperatures from 1650° to 2200° C has completed the checkout phase. (4) An experimental study to determine the phase equilibria between Y_2O_3 and four refractory metals (tungsten, rhenium, tantalum, and molybdenum) has revealed no intermediate compounds along the pseudobinaries Y_2O_3-W, Y_2O_3-Re, Y_2O_3-Ta, or Y_2O_3-Mo between 1500° and 2000° C. P.V.E.

N63-21296 General Dynamics/CONVAIR, San Diego, Calif.
ELECTROMAGNETIC INTERFERENCE TEST REPORT: ASTRONETIC RESEARCH, INC., SOLID-STATE DC TO DC CONVERTER MODEL 175
R. K. Walter Aug. 19, 1963 20 p
(GD/C 63-179)

The report covers tests on a dc-dc converter together with a radio interference filter. Specification limits were exceeded at 0.182, 5.7, 7.0, 8.0, and 10.0 mc. Intermodulation between systems was checked and no electronic interference among systems was noted. Of the vehicle systems studied, none was found susceptible to RF bands. Test results are presented as data sheets, tables, and graphs. E.K.R.

N63-21297 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADIO PHYSICS Quarterly Progress Report [Apr. 1-July 31, 1963]
J. W. Meyer and M. A. Herlin Aug. 30, 1963 15 p 2 refs
(Contract AF 19(628)-500)

This report summarizes the research and development efforts in the following areas: surveillance techniques, radio propagation, and plasma physics. P.V.E.

N63-21298 New York U., N.Y. Coll. of Engineering
NON-EUCLIDEAN GEOMETRIC REPRESENTATIONS FOR LOSSY MICROWAVE NETWORKS Eighth Scientific Report
L. J. Kaplan and D. J. R. Stock Jan. 1963 19 p Repr. from the J. of the Franklin Inst., v. 274, no. 6, Dec. 1962 p 475-487 9 refs
(Contract AF 19(604 -7486)
(AFCRL-63-37)

Application of non-Euclidean geometry to the representation of data obtained from single frequency measurements has been made on two-port networks especially in the microwave region. Lossless networks may be made the subject of a two-dimensional representation, but those providing loss as well as phase shift must be represented in three dimensions. This paper concerns itself with geometric representations for lossy two-port networks at single frequency. The invariant elements of the network transformation are considered in both two and three dimensions. The screw-like motion of points within the unit sphere due to transformation by a loxodromic bilinear transformation is considered in some detail. A two-dimensional projection is discussed, which may be used for actual computation; and a connection with the method of Deschamps is indicated. Author

N63-21309 Duke U., Durham, N.C.
INVERTER FOR USE WITH VERY LOW INPUT VOLTAGES
Thomas G. Wilson and Edward T. Moore [1962] 16 p 11 refs
(NASA Grant NsG-152-61, Suppl. 1-62)
(NASA CR-50936) OTS: $1.60 ph, $0.80 mf

A study is made of some of the problems involved in designing transistorized converters for use with low voltage supplies and to describe a d-c to a-c inverter which is particularly well suited for operation with a very low voltage input. This circuit also enables greater advantage to be taken of the potential efficiency of the transistor switches despite wide variations in the magnitude of the input voltage to the converter and in the load current drawn by the converter. Finally, a test circuit is described whose performance is illustrative of the efficiency and other characteristics of this type of inverter. J.R.C.

N63-21312 General Electric Co., Schenectady, N.Y. General Engineering Lab.
DEVELOPMENT OF LOW TEMPERATURE DIELECTRIC COATINGS FOR ELECTRICAL CONDUCTORS Annual Summary and 8th Quarterly Report
K. N. Mathes July 15, 1963 69 p refs
(NASA Contract NAS8-2442)
(NASA CR-51332) OTS: $6.60 ph, $2.27 mf

The results of an evaluation of low-temperature dielectric coatings (aromatic, polyimide; inorganic bonded, felted asbestos; polyvinylformal; polyvinyl chloride; polytetrafluoroethylene) intended for wire insulation in cryogenic applications

are presented. The polyimide polymers possess superior properties at cryogenic temperatures. Teflon has outstanding advantages where low dielectric losses are needed. Inorganic spacers possess advantages under intense radiation or where high-temperature, cut-through problems are involved, although aromatic polyimide also possesses tremendous resistance to thermal cut-through and excellent resistance to radiation for an organic material. P.V.E.

10 FACILITIES

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

N63-20706 Kellett Aircraft Corp., Willow Grove, Pa.
DETERMINATION OF OPTIMIZED PROPELLERS FOR GROUND EFFECT MACHINES Technical Report, May-Nov. 1962
N. J. Miller, M. M. George, and R. R. Pruyn Aug. 1963 118 p 9 refs
(Contract DA-44-177-TC-849)
(TRECOM TR-63-16)

Performance equations have been developed to predict the lift and power required for an arbitrary propeller and Ground Effect Machine (GEM) combination when operating in close proximity to the ground. A method for determining an optimum propeller is presented. A test program was conducted to obtain data for comparison with the analyses. The effect of the ratio of the propeller area to the jet area on performance was also determined. An analysis of the loads and moments produced on a propeller when operating in a duct is presented. Author

N63-20716 Army Engineer Waterways Experiment Station, Vicksburg, Miss.
THE WATERWAYS EXPERIMENT STATION SUMMARY OF CAPABILITIES
1962 38 p

Mission, history, organization, operation, physical facilities, and research areas of the Waterways Experimental Station at Vicksburg, Mississippi, are discussed. Research and engineering investigations are conducted in the fields of hydraulics, soil mechanics, concrete, mobility of military vehicles, nuclear weapons effects, and flexible pavement design. C.L.W.

N63-20720 Los Alamos Scientific Lab., N. Mex.
RADIATION MEASUREMENTS OF THE EFFLUENT FROM THE KIWI B-1A, B-1B, and B-4A REACTORS
J. W. T. Meadows et al Aug. 15, 1963 253 p 10 refs
(Contract W-7405-ENG-36)
(LAMS-2932) OTS: $3.50

A compilation of data documenting air and ground concentrations, particle sizes, and isotopic compositions of the radioactive effluents from the Kiwi B-1A, B-1B, and B-4A test reactors is presented. Also included is a description of the air-sampling trailers especially designed to house the dynamic-sampling equipment. The trailers are used to achieve a highly mobile sampling capability of any specific segment of 360° around the reactor as dictated by meteorological conditions. Data are also presented on the indirect radiation from the reactors, and radiation due to passage of the effluent clouds. Author

N63-20734 ARO, Inc., Arnold Air Force Station, Tenn.
VACUUM LEAD DETECTION AS APPLIED TO MAJOR SPACE ENVIRONMENTAL CHAMBERS
S. P. Ansley, Jr., and R. B. Williams Arnold Eng. Develop. Center, Aug. 1963 34 p 5 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-142)

The role of leak detection in the successful operation of large-scale space simulation chambers is discussed, and a general leak-detection program outlined. Methods, techniques, and equipment capabilities are presented along with the results of an actual leak-detection effort conducted on a 10,000-ft.^{3} space-simulation chamber. Author

N63-20787 Royal Norwegian Council for Scientific and Industrial Research, Blindern
THE ROCKET RANGE AT ANDØYA
Mar. 1963 17 p
(NSRC Rept. 2)

A rocket range has been established at Andøya in Northern Norway. Nike-Cajun or equivalent rockets can be fired from a zero-length launcher. A rather simple Doppler method is used in order to measure the slant range to the vehicle as a function of time during the flight. For well-behaved rockets like the Nike-Cajun, such a system is felt satisfactory. The purpose of the present paper is to describe some of the most important facilities at the range, to outline the operational procedure, and to discuss the experience gained from the first three launchings. Author

N63-20953 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany) Inst. für Angewandte Gasdynamik
BUILT-IN WIND TUNNEL BALANCES WITH STRAIN GAUGE STRIPS [ENTWICKLUNG VON WINDKANALEINBAUWAAGEN MIT DEHNUNGSMEFZATREIFENSYSTEMEN]
A. Heyser May 1963 70 p 17 refs In GERMAN
(DVL-261) Available from Vereinigte Universitats- u. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne 10 W. Germany

This review of built-in wind-tunnel balances with strain gage strips and possible measuring systems includes discussions of the following: (1) materials for the strips, such as bakelite, phenol resins, paper, and plastics; (2) the two-moment and the one-moment measuring systems; (3) the effects of the yawing and rolling moments on the pitch-moment system; (4) a balance with tension and compression measuring systems; (5) an axial-force measuring system with a balance built in a support; (6) a roll-moment measuring system; (7) a six-component balance; (8) test bars; (9) hysteresis at increasing loads for various steels; (10) the K-factor as a function of the temperature; (11) a bridge circuit with a link for temperature compensation; (12) an apparatus for conducting the temperature compensation in a built-in balance; (13) graphic results of the temperature compensation in a balance system; (14) an unassembled five-component balance; (15) a built-in five-component balance; (16) a three-component support balance, assembled and unassembled; (17) a five-component balance for power measurement on a control installed in a jet; (18) a spoiler balance; (19) a hydraulic locking device for a built-in balance; and (20) a three-component balance on a calibration "Jack." I.v.L.

N63-21080 Royal Norwegian Council for Scientific and Industrial Research, Blindern
ANDØYA – ROCKET SITE [ANDØYA – SKYTEFELTET OG RAKETTEN]
Knut W. Eriksen *In its* Danish-Norweg. Rocket Res. [1963] p 17-22 In NORWEGIAN; ENGLISH Summary (See N63-21076 21-01)

A description of the Andøya site chosen for the launching of the Danish–Norwegian Scientific Research Rockets is presented. It includes the main installations of the site, description of the two-stage Nike-Cajun, the launcher, ballistic data, safety precautions, and the procedure of preparing and launching the rocket. Author

N63-21325 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
LITHIUM-BOILING POTASSIUM REFRACTORY METAL LOOP FACILITY
J. P. Davis, G. M. Kikin, W. M. Phillips, and L. S. Wolfson Aug. 31, 1963 22 p
(NASA Contract NAS7-100)
(NASA CR-51236; JPL-TR-32-508) OTS: $2.60 ph, $0.86 mf

A 30-kw lithium-boiling potassium two-loop facility is presently under construction. The loop is totally constructed of columbium–1% zirconium alloy and will operate at temperatures up to 2100° F. The primary purposes of this loop facility are as follows: (1) To investigate overall transient and steady-state characteristics of a two-loop system which approximately simulates velocities, temperature, pressures, transit times, and heat fluxes in the range of actual system interest. (2) To obtain steady-state, local-boiling heat-transfer coefficients and two-phase pressure-drop data for a variety of operating parameters. (3) To evaluate components such as throttling valves, centrifugal pumps, hot traps, and experimental turbine-alternators for potential application to actual systems. Author

11 FLUID MECHANICS

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow, 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

N63-20705 Technical Research Group, Inc., Syosset, N.Y.
APPLICATION OF A SYSTEM OF BOLTZMANN EQUATIONS TO THE SEPARATION OF A BINARY GAS MIXTURE – II
Hanan Rubin Oak Ridge, Tenn., Union Carbide Nuclear Co., Aug. 27, 1963 24 p 5 refs
(Contract W-7405-eng-26)
(K-1580)

This report is a sequel to an earlier one on a theoretical study of the separation of a binary gas mixture by diffusion through a porous barrier. In both reports, the structure of the barrier is "averaged out," and a system of Boltzmann equations is approximated by a method of moments. In the present report, viscosity effects have been added and results have been obtained similar to those for a capillary. A precise comparison with the latter results is given. Author

N63-20742 Aberdeen Proving Ground, Md. Ballistic Research Labs.
DIRECTIONAL EFFECT OF CHARGE MOTION ON SHOCK FORMATION AT A SPHERICAL PENTOLITE CHARGE
Henry J. Goodman June 1963 46 p 20 refs
(BRL-1206)

The peak pressure at interaction of the explosive and ballistic shock in the direction of charge motion is estimated from hydrodynamic theory. Approximations to the flow conditions and shock propagation along this direction are made. The increase in peak pressure at the forward point of the ballistic shock varies from about 30% at charge velocity Mach 1.5 to about 150% at Mach 10. Comparison of differing approximations indicates that the major part of the increase results from pressure and entropy change within the ballistic shock, rather than from the airflow about the charge. Author

N63-20745 National Bureau of Standards, Washington, D.C.
ELECTRON OPTICAL STUDIES OF LOW-PRESSURE GASES [Final Report, Feb. 1, 1955–Mar. 1962]
L. Marton, David C. Schubert, and S. R. Mielczarek Aug. 16, 1963 44 p 47 refs
(NBS Monograph-66) GPO: $0.35

An electron optical method for the visualization of low-pressure gas flow has been developed which demonstrates the suitability of electron optical techniques for recording the spatial distribution of gas molecules at fixed times with sufficient accuracy that the velocity distribution could be derived. The work concentrated on the properties of chopped molecular beams of cadmium at extremely low pressures where the densities of the particles in the molecular beam pulse correspond to a pressure of less than 10^{-7} torr. P.V.E.

N63-20751 Massachusetts Inst. of Tech., Cambridge, Mass. Aerophysics Lab.
A ONE-DIMENSIONAL MODEL FOR COMPRESSIBLE FLOW IN THE TRAVELING WAVE PUMP [Interim Technical Report]
Eugene E. Covert and Charles W. Haldeman Wright-Patterson AFB, Ohio, Aeron. Res. Labs., May 1963 47 p 6 refs
(Contract AF 33(657)-7975)
(MIT-DSR 9015; ARL-63-83)

One possible technique for accelerating a plasma to a high Mach number is that of passing a magnetic field through the plasma. This technique, called the traveling-wave pump, is characterized by a complicated set of differential equations. These equations have been approximated by a one-dimensional steady-state form. Several approximate integrals are found for the one-dimensional equations. The results indicate that the viscosity losses in the system are not excessive. The results also indicate that the inlet-velocity profile should be as uniform as possible, and that the magnitude of the inlet velocity should exceed $\gamma - 1/\gamma$ times the wave speed by an appreciable amount. Author

N63-20752 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
VISUAL STUDY OF SWIRLING AND NONSWIRLING TWO-PHASE TWO-COMPONENT FLOW AT 1 AND 0 GRAVITY
David G. Evans Wahington, NASA, Aug. 1963 31 p 9 refs
(NASA TM X-725) OTS: $0.75

Flow visualization tests were made of various swirling and nonswirling two-phase two-component flow regimes at 1 and 0 g in a 1/2-in.-diam. clear plastic tube. Air and water at adiabatic-isothermal conditions were used as the two components. An analysis was made of high-speed motion pictures taken of the various flow regimes. The results of the analysis, presented in the form of flow models, indicated that gravity had an effect on the phase orientation and turbulence level of the flow. The use of a zero-gravity aircraft facility with the experimental package, either restrained or allowed to float freely inside the aircraft to achieve weightlessness, gave satisfactory and repeatable results. The relatively short periods of weightlessness, and the degree of variation from perfect weightlessness inherent in this type of facility, did not affect the results of the investigation. Author

N63-20769 RAND Corp., Santa Monica, Calif.
SIMILAR SOLUTIONS OF THE LAMINAR BOUNDARY-LAYER EQUATIONS WITH VARIABLE FLUID PROPERTIES
Joseph F. Gross and C. Forbes Dewey, Jr. Aug. 1963 39 p 11 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3792-PR)

This memorandum presents certain numerical solutions to the laminar boundary-layer similarity equations which illustrate the effects of Prandtl number, viscosity-temperature variation, mass transfer, wall temperature, pressure gradient, and hypersonic parameter σ on the structure of the boundary layer and the derivatives of velocity (shear force) and total enthalpy at the wall. The results show that the common boundary layer simplifications (such as Prandtl number = 1, viscosity proportional to temperature, zero pressure gradient) often lead to numerical errors of 20 to 50 percent in the predicted heat transfer, skin friction, and displacement thickness. The shear and enthalpy gradient are shown to depend on the form of the viscosity-temperature relation, the Prandtl number, and the hypersonic parameter σ. Results for high surface mass-injection rates at the stagnation point indicate that the shear at the wall does not vanish as in the case of a flat plate. Author

N63-20779 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
NORMAL SHOCK WAVE CALCULATIONS IN AIR AT FLIGHT SPEEDS UP TO 25,000 FT./SEC
C. A. Cook, L. M. Gilbert, and S. M. Scala. Nov. 1962 57 p 20 refs
(Contract AF 04(694)-222)
(R62SD76)

New calculations of the equilibrium gas properties behind a normal shock wave are presented based on the 1959 ARDC Model Atmosphere. Graphs of pressure, density, and temperature are presented for conditions behind a normal shock wave and at the stagnation point following an isentropic compression, for high-altitude hypersonic flight. The regime treated covers altitudes from 100,000 ft to 400,000 ft in increments of 2000 ft, and a range of flight speeds from 10,000 to 25,000 fps. Author

N63-20894 Argonne National Lab., Ill.
DEVELOPMENT OF AN ELECTRICAL RESISTIVITY PROBE FOR VOID-FRACTION MEASUREMENTS IN AIR-WATER FLOW
George P. Nassos (Northwestern U.) June 1963 38 p 14 refs
(Contract W-31-109-eng-38)
(ANL-6738)

Work has been done on the adaptation of an electrical probe, developed for the measurement of local void fractions in mercury–nitrogen flow, to air–water flow. The adaptation is more difficult because of wetting of the probe by water. Various probe shapes and filming agents were employed without great success. Some improvement was obtained by means of a separate triggering circuit, but the calculated void fraction was still somewhat low compared with that measured by the gamma-ray-attenuation technique. Author

N63-20915 Flugwissenschaftliche Forschungsanstalt, Munich (W. Germany)
CLOUD-FREE TURBULENCE AND THE RICHARDSON-CRITERION [WOLKENFREIE TURBULENZ UND RICHARDSON-KRITERIUM]
A. Jaffe Apr. 1963 64 p 24 refs In GERMAN
(FFM-58)

The Richardson criterion for predicting cloud-free turbulence was investigated by means of flight measurements. Results indicated that a cloud-free turbulence occurs under conditions of strong shifting of the wind, i.e., under conditions of low stability (which is predicted by the Richardson criterion). However, an accumulated occurrence of bumpiness in thin stabile layers (inversions, isotherms, tropopauses) must also be considered. The Richardson criterion can usually be verified in the free atmosphere; the Ri_{crit} lies at or above 1. I.v.L.

N63-20921 European Atomic Energy Community, Brussels (Belgium)
TWO-PHASE FLOW PROBLEMS
1963 151 p refs Proceedings of the Meeting of the Working Group Heat Transfer sponsored by the Euratom-United States Joint R. & D. Board, Brussels, Oct. 29–31, 1962
(EUR 352.e) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86 175 Belg. Fr.

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N63-20927 Douglas Aircraft Co., Inc., Santa Monica, Calif.
AN INVERSE METHOD FOR INVISCID IDEAL GAS FLOW FIELDS BEHIND ANALYTIC SHOCK SHAPES
R. A. Batchelder July 1963 132 p 10 refs
(SM-42588)

This report presents a highly accurate inverse (shock-initiated) solution for ideal gas (arbitrary constant gamma) flow fields around blunt bodies in supersonic or hypersonic flight. Both two-dimensional and axisymmetric cases are solved. Explanations, derivations, and discussions of numerical aspects are included. Diatomic gas results are presented for a variety of simple shock shapes, and for iterations upon the shock shape to produce body contours very close to spherical. Downstream pressures are found to be not significantly affected by moderate changes in nose-region shock shape. Author

N63-20952 General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.
DEPOSITION OF MATTER FROM A FLOWING STREAM. PART I: GENERAL RELATIONS AND EQUATIONS
L. F. Epstein and T. F. Evans Washington, AEC Div. of Tech. Inform., Dec. 1, 1962 46 p 40 refs
(Contract AT(04-3)-189)
(GEAP-4140) OTS: $1.00

The contamination of system components by radioactive species carried in the coolant of a nuclear reactor can cause problems in accessibility and maintenance. To examine this question, a physical model has been formulated in which the deposition process is determined by mass-transfer considerations and an adsorption-desorption mechanism. The bulk concentration of the contaminant in the fluid, and the surface concentration on the walls, are obtained as the solutions to two simultaneous partial differential equations in distance and time; and these solutions come out in terms of an integral involving Bessel functions of a purely imaginary argument. Tables for convenient evaluation of these functions are presented. The physical factors which determine the values of the parameters of this problem, and how they can be evaluated or estimated, are discussed in detail. Author

N63-20991 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
NONEQUILIBRIUM LAMINAR BOUNDARY LAYER FLOW OF A BINARY GAS
F. G. Blottner June 1963 59 p 15 refs
(Contract AF 04(694)-222)
(R63SD17)

The nonequilibrium boundary layer is considered as a binary mixture of atoms and molecules with finite rates of dissociation and recombination. To obtain accurate solutions to the partial differential equations for this type of flow without any necessary simplifying assumptions, an implicit finite-difference scheme is developed for solving these equations with a digital computer. Accurate solutions to the nonequilibrium boundary-layer equations have been obtained in a reasonable amount of computer time and are presented for a flat plate, cone, and hemisphere cylinder. The results show that the nonequilibrium boundary-layer temperature and composition can be considerably different from local equilibrium and frozen results. For a cone at 21,000 fps and 100,000 ft altitude, the computations show that at 60 ft from the tip, the flow has not reached equilibrium. Author

N63-20993 Naval Ordnance Lab., White Oak, Md.
SHOCK WAVES, DISLOCATIONS, AND THEIR INTERACTIONS
Paul Harris and S. J. Jacobs Apr. 4, 1963 30 p 40 refs
(NOLTR 63-94)

The existing macroscopic elastic-plastic theory is developed. Those aspects of the theory which are of special importance to shock propagation in solids, and which relate to the microscopic extension of the theory, are treated in length. The "hydrodynamic" equations are written in the elastic-plastic mode and should be usable by an experimentalist regardless of the exact microscopic processes involved. A gross theory is hypothesized to account for known phenomena associated with the shock loading of solids. In particular, it is suggested that dislocations are generated within the region associated with the plastic wave front, with the number generated being controlled by the applied normal stress-strain law for the material in question. Author

N63-21022 France. Minestere de l'Air, Paris
CONTRIBUTION TO THE LINEARIZED THEORY OF THE EFFECTS OF THIN JETS AND OF CAVITATIONS – CALCULATION OF FLOWS BY RHEOELECTRIC ANALOGY [CONTRIBUTION A LA THEORIE LINEARISEE DES EFFECTS DE JETS MINCES ET DE CAVITATIONS – CALCUL DES ECOULEMENTS PAR ANALOGIE RHEOELECTRIQUE]
Thoai-Sum Luu Paris Service de Documentation et d'Information Tech. de l'Aeron. (SDIT), 1962 135 p 28 refs In FRENCH
(*Its* Publ. Sci. et Tech. 389) Available from SDIT, 2, Ave. de la Porte-d'Issy, Paris (15e)

Theoretical flow studies which are discussed are as follows: (1) the deviation of the main jet due to an auxiliary jet which is slightly inclined; (2) the behavior of a thin jet at the peripheral exit of a diffuser; (3) the effect of a thin jet at the edge of the fairings of a stream-lined screw propeller; (4) flow around a cascade with blowing at the profile edge; (5) flow at the edge of a compressor distributor (guide vanes); (6) blowing at the under surface of a wing; and (7) supercavitating flows around smooth profiles. These studies were carried out within the framework of the linear theory of small perturbations for an ideal incompressible fluid. The flows are defined by the velocity potential of their perturbations and by their acceleration potential. The method adopted for schematizing the infinitely slender jet consists of imposing a Fourier condition, in which essentially the amount of motion produced is considered, on the scattering of the slender jet about a chosen axis. Likewise, a condition of Dirichlet is imposed upon the scattering of the flow path in order to represent this path at constant pressure, which constitutes the front of the wake according to Helmholtz or the front of a cavitation pocket. Each problem discussed is individually analyzed in order to define the limiting conditions which govern the velocity of the perturbation or the potential corresponding acceleration. The solutions have been calculated by the method of rheoelectric analogy or by analysis in certain particular cases. Trans. by lv.L

N63-21023 France. Ministere de l'Air, Paris
NEW ACCOMPLISHMENTS IN HYDRAULICS Part Four [NOUVEAUX COMPLEMENTS D'HYDRAULIQUE QUATRIEME PARTIE]
L. Escande Paris, Service de Doc. et d'Inform. Tech. de l'Aeron. (SDIT) 1963 232 p 24 refs In FRENCH
(*Its* Publ. Sci. et Tech. No. 395) Available from SDIT, 2, Ave. de la Porte-d'Issy, Paris (15e)

Recent studies in hydraulics are reviewed. These include: (1) liquid flow; (2) siphons for steady-flow rate; (3) erosions of the sandbanks of inlets in rivers and erosion of spillways having divided flow; (4) calculation of air reservoirs and the speed of waves and overpressures in forced conduits; (5) calculation of the pseudoperiod and damping of sustained oscillations in an equilibrium chamber; (6) stabilization of surge tanks by liquid resistances; (7) overpressures at the base of a constricted chamber; (8) surge tanks with power output; (9) determination

of the maximal downflow in a hydro-electric equilibrium chamber; (10) rhythmical maneuvering of water gates in surge tanks; and (11) calculation of the output of aqueducts for filling dry-docks. Trans. by M.P.G.

N63-21038 Weizmann Inst. of Science, Rehovoth (Israel)
PROPAGATION OF A PULSE IN A FLUID SPHERE Technical Note No. 7
Z. Alterman and P. Kornfeld July 22, 1963 55 p 2 refs
(Contract AF 61(052)-509; ARPA Proj. Vela-Uniform)
(AFCRL 63-882)

An exact solution is obtained for the motion of a uniform, compressible fluid sphere due to a pressure pulse from a point source situated at one-eighth of the radius below the surface. The solution reveals single diffracted pulses, and groups of diffracted pulses, which have no counterpart in ray theory. Author

N63-21073 Israel Program for Scientific Translations, Ltd., Jerusalem
APPLIED FLUID DYNAMICS [PRIKLADNAYA GIDROGAZODINAMIKA]
I. P. Ginzburg 1963 264 p 69 refs Transl. into ENGLISH 1958 Izdatei'stvo Leningradskogo Universiteta
(Published for NASA and NSF)
(NASA TT F-94; IPST Cat. 809) OTS: $2.75

"Applied Fluid Dynamics" discusses some of the problems of fluid mechanics which are frequently met with in the engineering design of various assemblies and engineering installations. New methods are presented for the solution of the problems of steady and unsteady flow of liquids and gases in pipes, their influx from vessels, problems of the filling and emptying times of vessels, the effect of a jet on a barrier, water hammer problems and other problems of fluid mechanics. C.L.W.

N63-21119 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
FORTRAN SOURCE PROGRAM FOR RETENTION OF GAS-LIQUID CHROMATOGRAPHY MEASUREMENTS
D. David Lawson and A. J. Havlik Mar. 26, 1963 13 p 6 refs
(NASA Contract NAS7-100)
(NASA CR-50996; JPL-TM-33-128) OTS: $1.60 ph, $0.80 mf

A typical set of experimental gas-liquid partition chromatography data for a homologous series of alcohols is reduced by a FORTRAN program. The program is designed to give values for the specific retention volumes, the partition coefficients, and the number of theoretical plates for each peak appearing on a chromatogram. In the course of the data reduction, other parameters of importance to the interpretation of results from gas-liquid partition chromatography measurements are also obtained. The reduction of the data by FORTRAN, a two-step process, is described. C.L.W.

N63-21123 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
FORTRAN SOURCE PROGRAM FOR REDUCTION OF GAS-LIQUID CHROMATOGRAPHY RETENTION DATA
D. David Lawson and A. J. Havlik May 1963 4 p 6 refs Repr. from J. Gas Chromatography, May 1963 p 17-20
(NASA Contract NAS7-100)
(NASA CR-51006; JPL-TR-32-449)

A FORTRAN source program for reduction of gas-liquid chromatography retention data is presented. The program is designed to give values for the specific retention volumes, the partition coefficients, and the number of theoretical plates for each peak appearing on a chromatogram. P.V.E.

N63-21164 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
EXPERIMENTAL STUDIES OF VIBRATIONAL AND DISSOCIATIVE NONEQUILIBRIUM IN EXPANDED GAS FLOWS
I. R. Hurle, A. L. Russo, and J. Gordon Hall N.Y., Am. Inst. of Aeron. and Astronautics [1963] 18 p 33 refs Presented at the AIAA Conf. on Phys. of Entry into Planetary Atmospheres, M.I.T., Aug. 26-28, 1963
(NASA Contract NASr-109; AF Contracts AF 49(638)-792, AF 33(657)-860)
(AIAA Paper 63-439) AIAA: $0.50 members, $1.00 nonmembers

Studies have been made of vibration and dissociation nonequilibrium effects produced in supersonic-nozzle expansions of diatomic gases from known equilibrium conditions attained behind reflected shock waves. The experiments were done in an axisymmetric, 15° conical nozzle attached to the end of a conventional shock tube. For the study of vibrational nonequilibrium without dissociation, nitrogen was shocked to reservoir temperatures and pressures in the ranges 2800° to 4600° K and 24 to 82 atm. The extent of vibrational excitation was determined by measurement of local vibrational temperatures using the spectrum-line reversal method. For the study of dissociation nonequilibrium without significant vibration, hydrogen-argon mixtures were shocked to a reservoir temperature of 6000° K and pressures from 28 to 112 atm. At these conditions the hydrogen (~8% mole fraction) was almost completely dissociated. Nozzle-wall pressure distributions were measured to observe effects due to nonequilibrium H_2 dissociation. The studies of N_2 vibration by the spectrum-line reversal method showed the vibrational temperatures in the nozzle flows to be much closer to equilibrium than the available relaxation theory predicts. The wall pressure measurements made in the studies of dissociated H_2 + Ar expansions showed a consistent reduction from equilibrium values. This reduction in static pressure is attributed to the occurrence of a lag in hydrogen atom recombination during the flow expansion. Author

N63-21204 Brown U., Providence, R.I.
FAR-FLOW APPROXIMATIONS FOR PRECURSOR IONIZATION PROFILES
Lewis Wetzel June 1963 35 p 25 refs Presented at AIAA Conf. on Phys. of Entry into Planetary Atmospheres, MIT, Aug. 26-28, 1963
(Contract Nonr(562)-35)

Two far-flow models are examined that have previously been introduced to account for the presence of precursor ionization ahead of a hypersonic shock front. Attention is centered on those profiles produced by shock radiation in gases whose photon-absorption cross sections are decreasing functions of energy above the ionization edge. Dramatic departures from simple exponential decay are found for gases like helium, atomic hydrogen and, to a lesser extent, argon, and molecular hydrogen and nitrogen. Moreover, the average energy of the photoelectrons rises significantly as one moves upstream. The diffusion model reduces, in the far-flow limit, to exponential decay governed by the free-electron diffusion length, regardless of the nature of the space-charge fields, although these fields might produce space-charge limited diffusion. Finally, the role of the onset region of a real shock is discussed as it affects the interpretation of these models. Author

N63-21221 Ohio State U. Research Foundation, Columbus Aerodynamic Lab.
THEORY AND PERFORMANCE OF A SHOCK TUBE HAVING AN ARC-HEATED DRIVER

John D. Lee and Robert M. Nerem June 15, 1962 37 p 4 refs
(Contract AF 33(616)-6782)
(RF-1021-18)

The pertinent design features, theory of operation, and some initial results are described for a shock tube which utilizes an arc-discharge in the high-pressure driving chamber. The tube has a diameter of four inches, with a 16-in.-long driver and a 35-ft. driven section. Power stored in a 6000-volt, 200,000-joule capacitor bank is discharged across coaxial electrodes in the prepressurized driver chamber. The arrangement was analyzed by assuming perfect gas parameters to obtain driven shock Mach-numbers as a function of initial pressures and energy of discharge. Both air and helium have been used in the driver, while air has been used exclusively in the driven section. Shock Mach-numbers up to 33 have been obtained to date. Wave speed is measured through the use of ionization gages, and pressure by piezoelectric pickups.

Author

N63-21232 Army Missile Command. Huntsville, Ala. Redstone Scientific Information Center
STUDIES OF THE EQUATION OF STATE IV. THE COMPRESSIBILITY EQUATION OF LIQUIDS
A. Wohl Aug. 28, 1963 12 p 9 refs Transl. into ENGLISH by JPRS from Z. Physik. Chem. (Frankfort), v. 99 (1921) p 234–241
(RSIC-50)

In studying the compressibility equation of liquids, a new compression equation is developed which assumes that a simple relationship exists between the compression coefficient β' and the sum of pressures when the molecules approach one another to the point where the resistance against further approach and the resistance against the reduction of the molecular volume becomes of the same order of magnitude, and such a state of affairs continues to persist at constant temperature within the pressure region under consideration. The interaction can then be described for each particular liquid by a single resistance coefficient of isothermal compression α. The assumption then leads to the equation, $\beta' = 1/v_o\ v/p = \alpha/K + p$ which, after integration, becomes $v_o - v/e^{\alpha v}o = 1 + p - p_o/K + p_o$.

P.V.E.

N63-21237 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
CHEMICAL KINETICS IN A REENTRY FLOW FIELD
M. H. Bortner Aug. 1963 101 p 173 refs
(R63SD63)

The role and principles of chemical kinetics in a flow field are discussed. On the basis of chemical kinetics, it is shown that the rate of the reaction is determined by the product of the reaction rate constant and the concentration of all reactants. In the reentry flow field many reactions occur, first of which are the dissociation reactions because the ambient particles are diatomic molecules. Ionization by collision and associative ionization reactions also occur, forming ions. The reaction rate constants are discussed with emphasis on O_2, N_2, and NO molecules, with O_2 taking preference in the investigations. The reaction rate constants for dissociation, rearrangement, and charge exchange reactions are discussed, along with associative and collisional ionization and attachment. Calculations, charts, and references are included.

J.L.C.

N63-21265 General Applied Science Labs., Inc., Westbury, N.Y.
LINEARIZED VISCOUS-FREE MIXING WITH STREAMWISE PRESSURE GRADIENTS
Martin H. Steiger and Martin H. Bloom (Polytechnic Inst. of Brooklyn) Aug. 1963 21 p 12 refs
(Grant AF-AOSR-1-63)
(GASL-TR-358)

Sets of similar solutions, applicable within a linearized approximation, are derived for two-dimensional compressible and axisymmetric incompressible viscous-free mixing with streamwise pressure gradients. Viewed as eigenfunctions, these solutions can be superposed to represent arbitrary initial conditions. However, it is observed that only one solution of the family possesses a net momentum defect (or excess) different from zero. This mode decays exponentially in the normal direction, and has a stronger streamwise persistence than any of the other solutions which have exponential normal decays; it is usually referred to as "the" similar solution.

Author

N63-21307 General Dynamics/Fort Worth, Tex.
DETERMINE FEASIBILITY OF FUSELAGE – WINDSHIELDS – TYPE K INTERLAYER – PROTECTION OF BY SATURATION WITH SELECTED NONDELETERIOUS GASES
H. P. Owen and M. T. Carroll Aug. 5, 1963 25 p
(Contract AF 33(600)-41891)
(FGT-3023)

Specimens for this test consisted of 1/2-in.-thick plugs of Type K interlayer molded and cured in glass tubes, and small simulated windshield specimen. Some of the 1/2-in. plugs of interlayer in the tubes were pretreated with helium, Freon 11, or a liquid amine before determining the rate of diffusion of SO_2 gas through the plug of interlayer. The 6- x 6-in. windshield specimens were vacuum impregnated with various liquid amines before exposing them to sunlight, moisture, and 10% SO_2. In all tests conducted, amino silanes appear to prevent or retard the passage of SO_2 through Type K interlayer.

Author

N63-21310 Aeronautical Research Council (Gt. Brit.)
EQUILIBRIUM REAL-GAS PERFORMANCE CHARTS FOR A HYPERSONIC SHOCK-TUBE WIND-TUNNEL EMPLOYING NITROGEN
L. Bernstein (Nat. Phys. Labs.) London, HMSO, 1963 41 p 14 refs
(ARC-CP 633; supersedes ARC 23232) Available from HMSO: 6s

Charts are presented covering a wide range of reflected-shock, wind-tunnel operating conditions, using nitrogen as the working gas. A statistical-mechanical model of the gas is assumed which takes account of molecular vibration, electronic excitation, and dissociation. The gas is assumed to be constantly in equilibrium, that is, the reaction rates are taken to be infinitely fast. The equations of motion are solved with the aid of a digital computer, with previously reported results for the state of the shock-processed gas in the shock tube being used.

Author

N63-21317 Brown Engineering Co., Inc., Huntsville, Ala. Scientific Research Labs.
CHARACTERISTIC RELATIONS OF COMPRESSIBLE FLOW WITH THREE INDEPENDENT VARIABLES
Vernon L. Reed Mar. 1963 65 p 6 refs
(NASA CR-51298; Tech. Note R-40) OTS: $6.60 ph, $2.15 mf

The theory of compressible, inviscid fluid flow was developed in order to establish a basis to evaluate flow fields. The hyperbolic, second-order, nonlinear, partial differential characteristics of the gasdynamic equations were solved using a coordinate transformation to a characteristic surface and a numerical finite-difference technique.

Author

N63-21318 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE DIFFUSION OF HYDROGEN AND OTHER LIGHT GASES THROUGH MEMBRANES, POROUS MEDIA, AND THIN PLATES: AN ANNOTATED BIBLIOGRAPHY
Charlie M. Pierce, comp. Oct. 1962 18 p 30 refs
(LMSC-6-90-63-31; SB-63-26)

This bibliography contains 30 selected references, dating from 1932, on the diffusion of light gases through porous and semiporous materials. Author

N63-21330 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PREDICTIONS OF THE STRUCTURE OF RADIATION-RESISTED SHOCK WAVES
Max A. Heaslet and Barrett S. Baldwin Repr. from Phys. of Fluids, v. 6, no. 6, June 1963 p 781–790 11 refs
(NASA RP-24)

The continuum, inviscid-flow equations of gasdynamics are used to predict the effect of thermal radiation on the internal structure of a shock wave. Numerical solutions of the governing equations show that considerable variation in the nature of the temperature and velocity profiles occurs, depending on the magnitude of the overall velocity change and the relative strengths of the radiative and convective energy fluxes. A unique feature of the work is the demonstration that, for a range of parametric values, discontinuities necessarily arise in the temperature and velocity profiles. The results include: (1) numerical integration of the basic equations for a representative range of parameters; (2) an analytic study of the equations by means of expansion procedures; (3) a study of the uniqueness of the solutions; (4) proof that previously published investigations cannot be generally applicable since they are restricted to continuous solutions; (5) prediction within a strong shock of a temperature maximum considerably larger than that corresponding to the Rankine–Hugoniot conditions. Author

N63-21340 Southwest Research Inst., San Antonio, Tex.
DYNAMIC BEHAVIOR OF LIQUID IN MOVING CONTAINER
H. Norman Abranson Repr. from Appl. Mech. Rev., v. 16, no. 7, July 1963 p 501–505 70 refs
(NASA Contract NASw-146)

A review is presented of problems dealing with the liquid dynamic behavior in moving containers, arising particularly from the problems of stability and control in rocket propellant tanks. The discussion covers the following areas: (1) liquid dynamic behavior in rigid containers—spherical containers, compartmented cylindrical containers, liquid rotational instability resulting from transverse excitation, and liquid motions resulting from vertical excitation. (2) liquid dynamic behavior in elastic containers—vibration characteristics of elastic shells partially filled with liquid, liquid motions resulting from shell breathing vibration, and liquid motions resulting from vertical excitation. Subharmonic response in both the liquid and container, liquid surface instabilities, amplitude dependence of the liquid frequencies, nonlinear coupling between liquid and container, etc., are all examples of the new order of complexity being encountered, virtually none of which can be anticipated from linear analysis. P.V.E.

12 GEOPHYSICS

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

***For Van Allen belts see:* 28 Space Radiation.**

***For related information see:* 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.**

N63-20718 Aracon Geophysics Co., Concord, Mass.
TERRESTRIAL FEATURES OF THE UNITED STATES AS VIEWED BY TIROS Scientific Report No. 2
John F. Cronin July 1, 1963 43 p 16 refs
(Contract AF 19(628)-2471)
(ARA-T-9219-4; AFCRL-63-664)

The photography of the Tiros meteorological satellite series is providing the first continuous view, from outside the atmosphere, of the earth's surface and its cloud masses. To assist in the problems of identification, due to the similarity of many clouds to certain terrestrial features, a map has been compiled portraying the United States as its surface features appear in Tiros photography. The ground patterns are those of late winter and early spring (February–April). This report, which is to accompany the map, is a compilation of photographs illustrating selected geographical features shown on the map or noted during its preparation, with descriptive comments on the nature of these features and why they are visible in the Tiros pictures. Author

N63-20743 Joint Publications Research Service, Washington, D.C.
DETERMINATION OF EARTHQUAKE EPICENTERS ON AN ELECTRONIC COMPUTER
I. I. Pyatetskiy-Shapiro, T. S. Zhelankina, V. I. Keylis-Borok, L. G. Pavlova, and P. T. Reznyakovskiy Sept. 6, 1963 7 p 3 refs Transl. into ENGLISH from Doklady Akad. Nauk SSSR (Moscow), v. 151, No. 2, July 1963 p 323–325 3 refs
(JPRS-20954; OTS-63-31692) OTS: $0.50

A method is discussed for the determination of earthquake epicenters by using a universal computer. The method is suitable for a case when the initial approximation is unknown and certain observations contain large errors. A program was prepared which makes it possible to use, for each earthquake, the data for not more than 150 of the total number of 1006 stations in the world whose coordinates (geocentric coordinates in which the computations are made) are stored on tape. A problem was formulated and the solution method was given. C.L.W.

N63-20747 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE DECREASE IN UPPER-ATMOSPHERE DENSITY BETWEEN 1957 AND 1963, AS REVEALED BY SATELLITE ORBITS
D. G. King-Hele and Janice M. Rees London, Min. of Aviation, May 1963 20 p 18 refs
(RAE-TN-SPACE-32)

The density of the upper atmosphere at heights of 200 to 750 km is calculated from the rate of decrease of orbital period for 38 satellites between October 1957 and January 1963. The air density at these heights is strongly linked with solar activity, and as solar activity declined between 1958 and 1962, the density decreased greatly, by a factor of about 5 at 400 km, and about 30 at 600 km. At heights above 300 km, the air density also varies greatly between night and day, with the daytime maximum exceeding the nighttime minimum by a factor which in 1960 was greater than 10 at heights of 600 to 700 km, but in 1962 never exceeded 5. Author

N63-20748 Alaska U., College Geophysical Inst.
THE CROSS MODULATION OF COSMIC NOISE: A TECHNIQUE FOR INVESTIGATING THE DISTURBED D REGION Scientific Report No. 1
Robert F. Benson May 1963 156 p 62 refs
(Contract AF 19(604)8833; DASA-WEB. 04.0063)
(UAG-R137; AFCRL-63-624)

The observed cross modulation of cosmic noise in the lower D region is found to be in better agreement with the alternate theory of cross modulation, proposed by Huxley in 1953, than with the current theory of cross modulation. The electron collision-frequency determinations are in agreement with the results of previous independent experiments. Author

N63-20753 Pennsylvania State U., University Park College of Engineering
IONOSPHERIC RESEARCH. WHISTLER MODE-IONIZED STREAM INTERACTIONS, PART I
O. E. H. Rydbeck and J. Askne June 15, 1963 64 p 5 refs
(Contract AF 19(604)-4563; and NSF Grant 18983)
(*Its* Sci. Rept. 187; AFCRL-63-482)

Whistler mode-ionized stream interactions are considered for various values of θ, the angle between the wave normal and the static magnetic field. This angle is initially assumed to be parallel to the infinitely wide ionized stream ($\theta = 0$). In this case, the forward whistler mode and the slow cyclotron wave do not interact, even if their phase velocities are equal, because they are oppositely polarized. When $\theta \neq 0$, there are eight possible waves which can interact in the system: four magnetoionic waves, two cyclotron waves, and two space charge waves. Backward whistler mode excitation is shown to be practically independent of θ as long as $\theta <$ arc cos $(\omega/\omega_p^{(2)})$, where $\omega_p^{(2)}$ is the electronic plasma frequency of the streaming medium. Backward whistler mode generation should therefore be a very probable phenomenon in the exosphere. Also when $\theta \neq 0$, the streaming medium can amplify the forward whistler mode due to a travelling wave interaction between the fast cyclotron wave and the forward whistler mode. For this forward amplification to occur, the stream must have an extremely small velocity spread. The general interaction properties of space charge waves are discussed although they have no essential effect in the whistler mode range. The wave propagation properties of a moving magnetoionic medium are examined. Finally, the general case when the stream also makes some angle θ_s with the magnetic field is studied. Backward whistler mode excitation is found to be essentially unaffected by this change, but the fast synchronous wave generated may degenerate into a forward whistler type mode. M.P.G.

N63-20763 Columbia U., Palisades, N.Y. Lamont Geological Observatory
TIDE AND STORM SURGE OBSERVATIONS IN THE CHUKCHI SEA Scientific Report No. 7
Kenneth L. Hunkins May 1963 44 p 15 refs
(Contract AF 19(604)-7442)
(AFCRL-63-616)

Sea-level heights were recorded with a tide gage at Fletcher's Ice Island while it was aground in the Chukchi Sea at 71°55' N, 160°20' W. Harmonic analyses were made for the tidal components. Storm surges observed at this location on the continental shelf have a range of about 40 cm. During relatively stationary atmospheric conditions, the storm surge heights can be interpreted as due to the static water-barometer effect. During conditions of moving atmospheric-pressure systems, storm surge heights differ from those predicted by the water-barometer effect. The combined application of Ekman's wind-driven current theory and Bernoulli's equation provides an explanation for these differences. Author

N63-20778 Florida State U., Tallahassee
THE POTENTIAL-ENERGY BUDGET OF THE STRATOSPHERE OVER NORTH AMERICA DURING THE WARMING OF 1957 Scientific Report No. 3
M. A. Lateef June 20, 1963 35 p 7 refs
(Contract AF 19(628)-394)
(AFCRL-63-689)

The evaluation of the terms in the balance equation for potential and internal energy was carried out using the 100-mb, 50-mb, and 25-mb values of geopotential, temperature, the geostrophic wind components, and adiabatic vertical motion at each point of a grid covering most of the North American Continent and the adjacent North Atlantic. The investigation considered a limited volume in which changes in potential and internal energy (alternatively referred to as total potential energy) were affected by flux of energy across the boundaries. Conversion of energy within the volume was from kinetic to potential energy throughout most of the period. The volume gained total potential energy through vertical transport of enthalpy across the upper boundary surface and lost total potential energy through transport across the lower boundary surface. The net effect was a gain in total potential energy during the early part of the warming period and a loss during the latter part. During the early stages of the warming, the volume lost total potential energy through net horizontal flux across the vertical boundaries. But during the period of pronounced warming throughout the volume, the same process brought about a large gain in total potential energy.

Author

N63-20840 Pennsylvania State U., University Park College of Engineering
IONOSPHERIC RESEARCH. SOME FEATURES OF THE F REGION ELECTRON DENSITY AND HEIGHT VARIATIONS IN THE EQUATORIAL REGIONS Scientific Report
Y. V. Somayajulu Sept. 1, 1963 32 p 24 refs
(Contract AF 19(604)-4563; and NSF Grant 18983)
(*Its* Sci. Rept. 192; AFCRL-63-817)

The average quiet day variations in maximum electron density (NmF) and h(0.9NmF) for the equatorial stations Talara and Huancayo are presented, derived from the true-height profiles for the five international quiet days for each of the IGY months. The results show that the forenoon and evening slopes of the Nm(t) curves, as well as the postsunset increase in the F-region heights, have similar semiannual variations. This semiannual variation has a close correlation with the variation of the cosine of the noon solar zenith angle of the sun, indicating that electrodynamic drifts are important in producing the observed seasonal variation. Vertical drifts alone are inadequate to account for the large slopes in the Nm(t) curves; east-west drifts, such as those observed experimentally, can cause large variations in these slopes. The phenomenon of the postsunset increase in F-region heights, and its seasonal variation, is explained. It is concluded that, in the equatorial regions, the ionospheric electrostatic fields play a dominant part in causing the equatorial anomalies.

Author

N63-20861 Aeronca Mfg. Corp., Baltimore, Md.
ULTRAVIOLET TECHNIQUES FOR DETERMINING GUIDANCE ACCURACY OF AIRBORNE MISSILES
M. J. Taubenslag *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14–15, 1960 p 129–135 (See N63-20851 21-23)

An ultraviolet system for determining miss distance of airborne missiles against practice targets is described. The system is defined by an equation. The system uses an FX-11 lamp as transmitter, with an average power of one watt; a 1P28 photomultiplier tube; a flat aluminum sheet, 1/2 meter on a side, as target; a good solar blind interference filter, for operating at 2515 Å; and xenon gas transmitting tubes. Author

N63-20882 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL ENVIRONMENTS – UPPER ATMOSPHERE
Milton Schach *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 1962 27 p 7 refs (See N63-20876 21-33)

The thermal environment in the earth's atmosphere at altitudes above 100 km, where the dominant mode of energy exchange is radiation, is considered, with emphasis upon the thermal balance of spacecraft placed in this environment. The external thermal environment of orbiting spacecraft consists of radiant energy from the sun, solar radiation reflected by the earth, and radiation emitted directly by the earth. The magnitude and spectral distribution of solar radiation is discussed and the solar constant defined. The thermal effect of solar radiation alone on a body in space depends on its absorptance of incident solar radiation, its temperature, and its thermal emittance; examples of thermal equilibrium with solar radiation are given. The effects of orbital factors, albedo, and earth-emitted radiation are then considered in addition to solar radiation, and the total spacecraft thermal balance is derived.
M.P.G.

N63-20883 Aircraft Armaments Inc., Cockeysville, Md.
THERMAL ENVIRONMENTS – LOWER ATMOSPHERE
Robert R. Mills, Jr. *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 1962 65 p 26 refs (See N63-20876 21-33)

Aerodynamically induced heating effects on a body moving through the lower atmosphere at speeds greater than or comparable to the ambient acoustical velocity are considered. The determination of the increased material temperatures due to frictional heating effects involves a knowledge of the complex relationships between the structural-geometrical properties of the vehicle, its prescribed trajectory, and the aerothermodynamic parameters involved. General aerodynamic heating theory is reviewed, including basic aerothermodynamic parameters, basic heat-transfer equations, thin-skin and thick-skin methods of computing temperatures, and heat-transfer coefficients for laminar, turbulent, and stagnation point flow convection. The relatively simple analytical methods discussed are used to determine the material temperature distributions of high-speed vehicles. A comparison of the theoretical results with experimentally measured temperatures on two different missile configurations indicates the validity of the approach described in this paper.
M.P.G.

N63-20976 Oslo U., Blindern (Norway)
STUDIES IN AURORAL SPECTROSCOPY Final Report
June 30, 1963 74 p 35 refs
(Contract AF 61(052)-252)
(AFCRL-63-854)

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N63-20977 Oslo U., Blindern (Norway)
STUDIES OF AURORAL LINES BY MEANS OF FABRY-PEROT INTERFEROMETERS
L. Harang and S. H. H. Larsen *In its* Studies in Auroral Spectroscopy June 30, 1963 p 4–8 2 refs (See N63-20976 21-12)

A discussion of the study of auroral lines by means of Fabry–Perot interferometers is presented. Interference pictures have been obtained of four complex atomic lines: OI: 8446·35/8446·76, OI: 7771·29/7775·40, NI: 5202·29/5199·85, and NII: 5004/5001. Of these four lines only OI 8446 and NI 5200 gave ring systems which could be analyzed and from which the line structure could be determined. The OI quintet at 7772 and the NII 5004/5001 doublet gave both broad and diffuse ring systems which have not been analyzed.
P.V.E.

N63-20978 Oslo U., Blindern (Norway)
INVESTIGATION OF THE STATE OF POLARIZATION OF THE RED AND GREEN O-LINES IN POLAR AURORAE
Ove Harang *In its* Studies in Auroral Spectroscopy June 30, 1963 p 9–11 1 ref (See N63-20976 21-12)

The effect of linear polarization in draperies and arcs of the red and green O-lines in polar aurorae was investigated by means of a suitable chopping photometer combined with a rotating polaroid disc. For polar aurorae no traces of linear polarization in the two lines 5577 and 6300 Å could be established. For circular polarization no effects could be found within a limit of about 5 to 10 percent.
P.V.E.

N63-20979 Oslo U., Blindern (Norway)
THE LUMINOSITY CURVE OF HIGH AURORA
L. Harang and A. Omholt *In its* Studies in Auroral Spectroscopy June 30, 1963 p 12–18 1 ref (See N63-20976 21-12)

The luminosity curve of high aurorae indicates that they cannot be caused by monoenergetic electrons penetrating along the magnetic field lines. It is indicated that a composite bundle of electrons, dispersed in energy as well as in the angle which their paths make with the magnetic field lines, would be needed to account for the observations obtained.
P.V.E.

N63-20980 Oslo U., Blindern (Norway)
STUDIES OF RAPID VARIATIONS OF CERTAIN LINES AND BANDS IN THE AURORAL SPECTRUM
A. Omholt *In its* Studies in Auroral Spectroscopy June 30, 1963 p 19–20 3 refs (See N63-20976 21-12)

In studying the rapid variations of certain lines and bands in the auroral spectrum, a series of measurements with a two-channel photoelectric filter photometer were made. The Meinel N_2^+ bands, the First Positive N_2 bands, and the Second Positive N_2 bands were each compared with the First Negative N_2^+ bands. Where the aurora showed rapid variations, the photometer was kept in a fixed position and the intensities of the two bands in question were recorded by the photometer. The results indicated that there are no significant time shifts between the maxima of any two intensities. However, when the intensity ratio between the bands is considered, there seems to be a systematic variation with the rapidity of the intensity changes. P.V.E.

N63-20981 Oslo U., Blindern (Norway)
THE HYDROGEN LINES IN AURORA
A. Omholt *In its* Studies in Auroral Spectroscopy June 30, 1963 p 21–26 2 refs (See N63-20976 21-12)

The hydrogen lines emitted from aurora in and close to the auroral zone have been studied with a new photoelectric scanning spectrograph. The observations showed that the hydrogen emission at high latitude is mainly associated with diffuse glow; in no case H_α emission was observed in stronger distinct auroral forms appearing during the same period. In some cases, but not all, a dark belt occurred in between the hydrogen emitting area of the sky and the area where brighter forms appeared. The intensity of H_α was usually of about the same as that of the red oxygen lines 6300/64 Å, whereas the First Positive N_2 bands in the same spectral range usually were too weak to be recorded. P.V.E.

N63-20982 Oslo U., Blindern (Norway)
VELOCITIES OF VERY ACTIVE AURORAL RAYS
A. Omholt *In its* Studies in Auroral Spectroscopy June 30, 1963 p 27–28 1 ref (See N63-20976 21-12)

The east-west speed of rays in very active aurorae were measured with a photoelectric photometer in which the auroral form was focused on two vertical slits, and the relative time delays between the maxim of east-west moving rays and draperies was determined. Of the rays studied, 14 moved eastwards and 7 westwards. The measured velocities averaged 24 km/sec; the highest being 30 km/sec, and the lowest 13 km/sec. P.V.E.

N63-20983 Oslo U., Blindern (Norway)
THE COMPENSATED MICHELSON'S INTERFEROMETER AND ITS USE IN AURORAL SPECTROSCOPY IN THE NEAR INFRA-RED
Ove Harang *In its* Studies in Auroral Spectroscopy June 30, 1963 p 29–39 6 refs (See N63-20976 21-12)

A description of a compensated Michelson's interferometer and its use in auroral spectroscopy in the near infrared is presented. P.V.E.

N63-20984 Oslo U., Blindern (Norway)
THE DISCHARGE THEORY OF THE NIGHTGLOW EMISSION OI 5577 Å
A. Omholt *In its* Studies in Auroral Spectroscopy June 30, 1963 p 40–42 1 ref (See N63-20976 21-12)

Theoretical computations on possible optical effects of horizontal currents were carried out in order to investigate the responsibility of horizontal discharges in the E-layer for the nightglow OI 5577Å emission. From the computations it appears that the electric currents in the ionosphere could not be responsible for the excitation of the green OI line, and that it would appear more reasonable to assume that the maximum electron density in the E-layer during steady state, night-time conditions is higher than $10^3 cm^{-3}$, thus electron excitation could be completely disregarded. P.V.E.

N63-20985 Oslo U., Blindern (Norway)
OBSERVATIONS AND EXPERIMENTS PERTINENT TO AURORAL THEORIES
A. Omholt *In its* Studies in Auroral Spectroscopy June 30, 1963 p 43–45 1 ref (See N63-20976 21-12)

A review of recent observational results pertinent to theories on auroral primary particles in space is presented. It is pointed out that even if fast electrons are responsible for the main auroral forms, there is a possibility that proton precipitation zones exist outside those of electrons (as seen from the poles), and where protons may be the dominating kind of energetic particles injected into the atmosphere from space. It is concluded that although storage of particles in the radiation belts is intimately connected with aurorae, it is unlikely that aurorae are due to particles which have been stored for any length of time in the earth's magnetic field. In making estimates of the space charge necessary to create the observed curl of auroral bands, high values (0.1 net proton charge per cm^3) are arrived at. This space charge would create prohibitively large potential differences along the path of the electrons (in the range of hundreds kev). Therefore it is unlikely the space charge is a dominant cause for such break-up and curling up of auroral forms. P.V.E.

N63-20986 Oslo U., Blindern (Norway)
EXCITATION OF THE A10-BANDS IN THE SUNLIT ATMOSPHERE AND TEMPERATURE DETERMINATIONS FROM THE VIBRATIONAL LEVELS
Ove Harang *In its* Studies in Auroral Spectroscopy June 30, 1963 p 46–58 7 refs (See N63-20976 21-12)

Excitation of the A10-bands in the sunlit part of the twilight atmosphere was accomplished by exploding a charge of TNT from a rocket. An analysis of the vibrational bands produced gave a temperature value of 1250° K. P.V.E.

N63-20987 Oslo U., Blindern (Norway)
OBSERVATIONS OF ENHANCED RADIATION IN THE KC/S-BAND (5 AND 8 KC/S) DURING AURORAE AND GEOMAGNETIC DISTURBANCES
L. Harang and R. Larsen *In its* Studies in Auroral Spectroscopy June 30, 1963 p 59–72 10 refs (See N63-20976 21-12)

The appearance of the VLF-radiation bursts (8 kc/s and 5 kc/s) during various types of geomagnetic disturbances is discussed. The VLF-bursts have their greatest amplitudes during the positive phase of the geomagnetic storm and often during only slight disturbances. During great and negative disturbances, when the auroral zone is displaced laterally towards the south and strong absorption overhead appears indicated by the considerable rheometer deflections, the VLF-burst activity, decreases. Simultaneous records on 5 and 8 kc/s show a closely parallel amplitude variation, but the relative magnitude of the amplitudes may change during the period of burst activity, indicating a change in the spectral composition of the bursts. Reception on E-W and N-S orientated frames show that the mean "zero"-level of hiss during undisturbed conditions is different, it is stronger from the east-west than from the north-south direction. VLF-bursts arrive with amplitudes of the same order of magnitude in both frames. P.V.E.

N63-21000 Aerojet-General Corp., Azusa, Calif.
ROCKETS IN SPACE ENVIRONMENT. VOLUME II – THE SPACE ENVIRONMENT Final Report

N. A. Williams and D. Christensen Edwards AFB, Calif., Rocket Propulsion Lab., Feb. 1963 118 p 116 refs
(Contract AF 04(611)-7441)
(RTD-TDR-63-1050; Aerojet-2484, Vol. II)

Factors constituting the space environment between 300 and 22,000 n.mi. altitude are discussed and defined. These factors are ionizing-particle radiation (including Van Allen, solar flare, and primary cosmic radiation), electromagnetic radiation (from both earth and sun), temperature and pressure in the exosphere, and meteoroids (both asteroidal and cometary). Author

N63-21004 Stanford U., Calif. Radioscience Lab.
THE CALCULATION OF ELECTRON DENSITY PROFILES FROM TOPSIDE SOUNDER RECORDS
J. O. Thomas, A. R. Long (Cambridge U.), and D. Westover Repr. from J. Geophys. Res., v. 68, no. 10, May 15, 1963 p 3237–3242
(NASA Grant NsG-30-60)

An ionosonde, in a vehicle immersed in the plasma above the peak of the F_2 layer of the ionosphere, measures as a function of frequency f, the virtual depth h' below the vehicle, at which radio waves are reflected from the topside of the ionsophere. In this paper, a method is presented for converting the observed topside $h'(f)$ curves into electron-density profiles. Author

N63-21039 Air Force Cambridge Research Labs., Bedford, Mass.
A REEXAMINATION OF LORD RAYLEIGH'S DATA ON THE AIR 5577 A[OI] EMISSION
G. J. Hernandez and S. M. Silverman June 1963 29 p 39 refs
(AFCRL-63-835)

Rayleigh's published data on the airglow green line covering an entire sunspot cycle have been little used because of the manner of presentation. These data have been reexamined and the results for the different stations put on a common basis and converted to present-day units. The assumptions and constants used by Rayleigh in his absolute calibration have been carefully checked, with a resulting small change in the absolute intensity that he had reported. Since Rayleigh worked with wide bandpass filters, a discussion of current knowledge of the night-sky continuum and its correlation with the green line has also been included. Author

N63-21040 Naval Research Lab., Washington, D.C.
THE NRL SEMIAUTOMATIC ATMOSPHERIC ELECTRICITY STATION [Interim Report]
R. V. Anderson June 6, 1962 24 p 8 refs
(NRL-5787)

The atmospheric electricity station, composed of an electric-field meter, conductivity chamber, accompanying amplifiers and timers and peripheral apparatus has been used successfully to produce continuous recordings of the electrical field and conductivity of the atmosphere. The installation, operation, and maintenance of this complete station is given in this report. Author

N63-21075 National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
AN ANALYTICAL SOLUTION FOR DENSITY DISTRIBUTION IN A PLANETARY EXOSPHERE
C. S. Shen Repr. from J. Atmospheric Sci., v. 20, No. 2, Mar. 1963 p 69–72 2 refs
(NASA RP-15)

An analytical expression is derived for the density distribution in a planetary exosphere. It is shown that according to a strict collisionless exosphere model the particles in the velocity space are confined in a region bounded by a hyperbola and a quarter circle. Outside this region there are no particles; inside, they are distributed by a Maxwellian law. The physical significance of this difference and its effect on the escape rate are discussed. Author

N63-21078 Norwegian Inst. for Cosmic Physics, Blindern
PERSPECTIVES FOR GEOPHYSICAL RESEARCH IN THE HIGHER ATMOSPHERES [PERSPEKTIVER FOR GEOFYSISK FORSKNING I DEN HØYERE ATMOSPHAERE]
Bjørn Landmark and Anders Omholt *In* Roy. Norweg. Council for Sci. and Ind. Res., Blindern Danish-Norweg. Rocket Res. [1963] p 6–11 In NORWEGIAN; ENGLISH Summary (See N63-21076 21-01)

The possibilities offered to the scientist by rockets and satellites for the study of the physics of the upper atmosphere and related phenomena are discussed. A summary of the present activities in Norway in this field is presented. The research programme, including the use of research rockets, for the next few years is outlined. Author

N63-21079 Norwegian Defence Research Establishment, Kjeller
THE SCIENTIFIC AIMS OF THE DANISH-NORWEGIAN ROCKET PROJECT [DEN VIDENSKAPELIGE MÅLSETNING FOR DET DANSK-NORSKE RAKETT-PROSJEKT]
Jørgen Rybner (Tech. U., Copenhagen) and Olav Holt *In* Roy. Norweg. Council for Sci. and Ind. Res., Blindern Danish-Norweg. Rocket Res. [1963] p 12–16 In NORWEGIAN; ENGLISH Summary (See N63-21076 21-01)

The development of Scandinavian cooperation in near space research is reviewed. General principles of some experiments in which rockets are used in ionospheric research are presented. The first Danish–Norwegian experiments are roughly described, with a brief discussion of the results obtained from the first launching at Andoya. Author

N63-21082 Technical U., Copenhagen (Denmark)
ANDØYA – ROCKET BORNE MEASURING EQUIPMENT [ANDØYA – DET RAKET-BARNE MALEUDSTYR]
Ove E. Petersen *In* Roy. Norweg. Council for Sci. and Ind. Res., Blindern Danish-Norweg. Rocket Res. [1963] p 29–36 In NORWEGIAN; ENGLISH Summary (See N63-21076 21-01)

The principles involved in measuring electron density and collision frequency by rocketborne equipment are outlined. Development of an instrumentation package for Nike-Cajun rocket is reported. Particular attention is given to the influence of Doppler and spin effects upon the measurements, to miniaturization, and to environmental testing. Author

N63-21084 Norwegian Meteorological Inst., Blindern Institut of Astrophysics
NORWEGIAN PARTICIPATION IN THE FRENCH ROCKET EXPERIMENTS IN THE SAHARA [NORSK DELTAGELSE I DE FRANSKE RAKETTFORSØK I SAHARA]
Leiv Harang *In* Roy. Norweg. Council for Sci. and Ind. Res., Blindern Danish-Norweg. Rocket Res. [1963] p 42–44 In NORWEGIAN; ENGLISH Summary (See N63-21076 21-01)

In a series of rocket launchings, TNT was exploded at a height of 120 to 150 km. The experiments were made just after sunset and took place in the sunlit ionosphere. A luminous cloud appeared which was visible for 10 to 12 minutes. The spectrum consisted of a series of 10 Å bands. The spectrum was recorded by a light-sensitive recording spectrometer, one spectrum being recorded every minute. These spectra are now being analyzed, and will provide data for the discussion of the temperature and the physical condition of the sunlight. Author

N63-21107 Stanford U., Calif. Radioscience Lab.
BIBLIOGRAPHY OF THE IONOSPHERE: AN ANNOTATED SURVEY THROUGH 1960 Final Report
Laurence A. Manning May 1962 622 p 3505 refs
(Contract AF 19(604)-6194)
(SEL-62-064; AFCRL-62-188)

An annotated bibliography is presented of papers that deal with ionospheric radio propagation, radio studies of the ionosphere or physics of the ionosphere important to radio studies. Examples of such topics are radio studies of the aurora, rocket studies of the upper atmosphere, eclipse effects on radio propagation, recombination and diffusion processes in the F region, solar effects on the ionosphere, and the formation of ionized meteor trails. C.L.W.

N63-21110 Michigan U., Ann Arbor Coll. of Engineering
A SURVEY OF PROGRESS AND PROBLEMS IN THE "KAPLAN" EXPERIMENT Technical Report
S. Roland Drayson July 1963 15 p 17 refs
(NASA Contract NASr-54(03); ORA Proj. 05863)
(NASA CR-51071) OTS: $1.60 ph, $0.80 mf

This paper discusses the development of L. D. Kaplan's suggestion that measurement of the intensity of the outgoing infrared radiation of the earth and its atmosphere could provide a detailed analysis of the thermal structure and water vapor concentration in the atmosphere. Problems arise in the following areas: (1) calculation of the intensity of the outgoing radiation; (2) the inversion of the radiation equation; (3) a decision on the best frequencies and resolutions for making the measurements; and (4) a consideration of the errors involved and an attempt to minimize them. Possible solutions to these problems are presented. Since the temperature distribution must be found before the water vapor concentration can be calculated, most attention is given to the 15μ CO_2 band which has a relatively simple structure. E.K.R.

N63-21114 International Geophysical Year World Data Center A, Washington, D.C.
ELEVENTH 6-MONTHLY CATALOGUE OF DATA IN IGY WORLD DATA CENTER A Data Received by WDC-A During the Period 1 July-31 Dec. 1962
Washington, Natl. Acad. of Sci., May 1963 206 p refs
(IGY General Rept. 19) NAS-NRC: $1.00

The IGY catalog data are presented under the following headings: (1) Solar-terrestrial relationships and space physics—airglow and ionosphere, aurora (instrumental and visual), cosmic rays, solar activity, rockets and satellites, geomagnetism. (2) Solid-earth and earth-atmosphere interface—gravity and seismology, longitude and latitude, glaciology, oceanography, meteorology, and nuclear radiation. P.V.E.

N63-21157 National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
MEAN ELECTRON DENSITY VARIATIONS OF THE QUIET IONOSPHERE NO. 11 – JANUARY 1960
J. W. Wright, L. R. Wescott, and D. J. Brown Aug. 30, 1963 56 p 5 refs
(NBS-TN-40-11) GPO: $0.40

A program for large-scale computation of electron-density profiles from ionospheric vertical soundings has been initiated. Scaling is performed at field stations, permitting computation of hourly profiles at the Central Laboratory. These profiles are combined to form hourly mean quiet profiles for each station and month. The results of this program for the month of January are illustrated graphically. This report illustrates the electron-density variations in the mean quiet ionosphere between latitudes 15° N and 50° N along the 75° W meridian. Author

N63-21170 Pennsylvania State U., University Park. Coll. of Engineering
THE IONOSPHERIC CONDITIONS
Marcel Nicolet and William Swider, Jr. Sept. 10, 1963 54 p 53 refs
(Contract AF 19(604)-4563; NSF G-18983)
(Sci. Rept. 193; AFCRL-63-834)

A general analysis of ionospheric conditions has been made in the light of possible ionic reactions occurring in the upper atmosphere. Data obtained on various parameters, such as the ionic production and recombination, show that precise knowledge of the spectral distribution of solar radiation is needed, and that other experimental determinations on the dissociative recombinations are required. Author

N63-21202 Israel Inst. of Tech., Haifa
MAGNETO-IONIC MODE PROPAGATION IN THE IONOSPHERE: THE DIRECTION OF MINIMUM ABSORPTION OF A HOMOGENEOUS PLANE WAVE TRAVERSING A HOMOGENEOUS IONOSPHERIC SLAB Technical Report No. 3
C. Altman and H. Cory Feb. 28, 1963 16 p 8 refs
(Contract AF 61(052)-555)
(AFCRL-63-650)

The absorption of homogeneous, plane radio waves propagating through an idealized homogeneous ionospheric region in the magnetoionic mode in various directions in the magnetic meridian plane is examined. It is found that minimum absorption between two fixed heights is generally obtained when the wave normal is in a direction lying between the vertical and the direction of the geomagnetic field; however, the percentage variation in total absorption between these two limits is small, and one may use either the condition of vertical incidence or the condition of field-aligned propagation as an approximation to the condition of minimum absorption. For waves incident on a physical ionosphere from below, this treatment is invalid, and the problem must be solved by making use of the Booker quartic equation. Author

N63-21235 Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmospheric Physics Lab.
ATMOSPHERIC STRUCTURE AND ITS VARIATIONS IN THE LOWER THERMOSPHERE
Kenneth S. W. Champion June 1963 26 p 25 refs
(AFCRL-63-873)

This report discusses the intermediate altitude region (the lower thermosphere, lying between approximately 100 and 200 km). Some rocket data are available for the lower thermosphere, but most of the measuring instruments are experimental and a major part of the data analysis consists of studying the physics of the various corrections or calibration factors required. At the upper end of the altitude regime some satellite data are available. The satellite data indicate a dependence of density on the value of the magnetic A_p index. Otherwise, the data show more variation with the method of measurement and data reduction than actual variation of the atmosphere. Recent values of temperature include those deduced by the author from density data and measurements based on the broadening of the sodium and potassium resonance line and from aluminum oxide bands. Probably the most important property of the lower thermosphere is composition. In this region there are major changes with altitude, primarily due to dissociation of oxygen and nitrogen. The composition throughout the upper atmosphere (including the exosphere) is almost entirely determined by that in the lower thermosphere. In addition to recent theoretical models, new results obtained with mass spectrometers and solar ultraviolet absorption are discussed. Author

N63-21271 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A MICROMETEOROID VELOCITY DETECTOR
Frank Neuman (Stanford U.) Washington, NASA, Sept. 1963 58 p 13 refs
(NASA TN D-1977) OTS: $1.50

A feasibility study for a particular type of particle velocity detector is made. The detector considered consists of two light screens with known spacing. A particle penetrating the successive light screens scatters light which is detected by means of photomultiplier tubes. The time difference between the photomultiplier tube outputs is a measure of the particle velocity. Author

N63-21272 National Aeronautics and Space Administration, Washington, D.C.
IONOSPHERIC WINDS: MOTIONS INTO NIGHT AND SPORADIC *E* CORRELATIONS
N. W. Rosenberg, H. D. Edwards, and J. W. Wright (Georgia Inst. of Tech.) Sept. 1963 19 p 10 refs Presented at the COSPAR Meeting, Warsaw, June 1963
(NASA Grant NsG-304-63)
(NASA TN D-2114) OTS: $0.50

The persistence of night winds and shears for more than 5 hours after sunset at altitudes between 100 and 150 km was evaluated. Comparisons are made between the winds and shears observed under night conditions with those for the preceding twilight period. These data tend to verify the correlation between wind shear and sporadic E. Author

N63-21278 Stanford U., Calif. Radioscience Lab.
THE CALCULATION OF ELECTRON DENSITY PROFILES FROM TOPSIDE SOUNDER RECORDS
J. O. Thomas, A. R. Long (Cavendish Lab., Cambridge, Gt. Brit.), and D. Westover Repr. from J. Geophys. Res., v. 68, no. 10, May 15, 1963 p 3237–3242 11 refs
(NASA Grant NsG-30-60)

An ionosonde in a vehicle immersed in the plasma above the peak of the F_2 layer of the ionosphere measures, as a function of frequency f, the virtual depth h' below the vehicle at which radio waves are reflected from the topside of the ionosphere. In this paper, a method is presented for converting the observed topside $h'(f)$ curves into electron-density profiles. Author

N63-21279 Stanford U., Calif. Radioscience Lab.
THE ELECTRON DENSITY DISTRIBUTION ON THE F_2 LAYER OF THE IONOSPHERE IN WINTER
J. O. Thomas Repr. from J. Geophys. Res., v. 68, no. 9 May 1, 1963 p 2707–2718 18 refs
(NASA Grant NsG-30-60)

This paper describes the winter daytime enhancement of ionization observed under certain circumstances in the F region of the ionosphere. The existence and magnitude of this region of enhanced ionization (referred to as the winter spur) depends strongly on latitude and on the solar cycle epoch. Its relationship with the well-known winter anomaly is discussed. The evidence seems to point to a downward flux of electrons from above the peak of the F_2 layer as the most likely cause of the winter spur. Author

N63-21280 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IONOSPHERIC RESEARCH FROM SPACE VEHICLES
R. E. Bourdeau Repr. from Space Sci. Rev., v. 1 (1962–1963) p 683–728 16 refs
(NASA RP-21)

Interdisciplinary experimental data are compared with theoretical models of the D, E, and F regions, as well as the upper ionosphere, in order to select those models which best fit spaceflight observations. Areas covered by the comparison include: (1) the D region under quiet solar conditions, (2) the D region during disturbed solar conditions, (3) the ion content of the lower ionosphere, (4) the diurnal and anomalous behavior of the E region, (5) the formation of the F2 peak, (6) the helium ion layer and the protonosphere, (7) the diurnal variation of electron density in the upper ionosphere, (8) the altitude dependence of charged particle temperature, and (9) diurnal variation of upper ionosphere temperatures. P.V.E.

N63-21311 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONSTITUTION OF THE ATMOSPHERE AT MAGNETOSPHERIC LEVELS
S. J. Bauer Washington, NASA, Feb. 1, 1963 8 p 35 refs
(NASA TM X-50424; NASA X-615-63-22) OTS: $1.10 ph, $0.80 mf

A study is made of the composition and temperature of the atmosphere at magnetospheric levels. The main contributions to our knowledge of the constitution of the atmosphere at magnetospheric levels have been the identification of helium as an important constituent and direct measurements of the thermal properties of this region as a function of altitude, latitude, and time. The kinetic gas temperature of the atmosphere at magnetospheric levels has been determined from satellite drag observations, assuming model distributions of the mean molecular weight. J.R.C.

N63-21334 Iowa State U., Iowa City
DEFORMATION OF MAGNETIC SHELLS DURING MAGNETIC STORMS
S.-I. Akasofu (Alaska U.) Repr. from J. of Geophys. Res., v. 68, no. 15 Aug. 1, 1963 p 4437–4445 17 refs
(NASA Grants NsG-233-62 and NsG-201-62)

Examined is the nature of the distortion of the earth's magnetic field in the radiation belt regions for the combination of two external sources of the distortion, the ring current, and the solar plasma flow. The distortion is expressed by diagrams showing the location of two points on the distorted lines of force, the radial distance r_e of a point at which the line of force crosses the equator, and its anchoring latitude ϕ (or $L = 1/\cos^2\phi$) on the earth's surface. The r_e-ϕ(or r_e-L) diagrams thus constructed are of use in a study of the deformations of the outer radiation belt. Author

N63-21347 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DISCUSSION OF OUR EARLIER HYDROMAGNETIC INTERPRETATION OF SUDDEN COMMENCEMENTS OF MAGNETIC STORMS
Charles R. Wilson and Masahisa Suguira Repr. from T. Geophys. Res., v. 68, no. 10, May 15, 1963 p 3314–3320 17 refs
(Contract AF 19(604)-7988 and NSF Grant)
(NASA RP-20)

An interpretation of sudden commencements (SC's) of magnetic storms is discussed. A summary of the interpretation of SC's is presented as follows: The primary effect of the impact of a solar gas cloud on the surface of the magnetosphere is to create a longitudinal hydromagnetic shock wave. Since, near the equatorial plane, the magnetic field is nearly perpendicular to the equatorial plane, the longitudinal hydromagnetic wave propagates toward the earth essentially in this mode. Because of the curvature of the lines of magnetic force, the longitudinal hydromagnetic wave generates transverse

hydromagnetic waves by coupling. These transverse hydromagnetic waves are transmitted to the earth essentially along the lines of magnetic force. The coupling is most effective in the outer regions of the magnetosphere where the magnetic field is weak; from these regions the transverse hydromagnetic waves propagate to the earth in high latitudes. P.V.E.

13 HEAT TRANSFER

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

N63-20699 Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
EVALUATION OF SURFACE-ATTACHED THERMOCOUPLES DURING FORCED CONVECTION HEAT TRANSFER
Edward Richard Oetken June 17, 1963 90 p 5 refs
(Contract AT(10-1)-205)
(IDO-16889)

Metal-clad thermocouples with a flat (spade) tip were used to measure the temperature of a 0.030-in.-thick metal plate acting as a forced-convection heat-transfer surface. The thermocouples were found to change the temperature of the plate at the point of attachment by 40 percent of the temperature difference between fluid and plate. This value was found to be independent of fluid velocity, heat flux, and fluid temperature. A heat transfer model of the thermocouple was developed and analyzed to determine the "effective fin height" of the thermocouple at four test conditions. An evaluation of brazing and resistance spot welding for attaching the thermocouples to the plate was made. Author

N63-20704 Little (Arthur D.), Inc., Cambridge, Mass.
DEVELOPMENT OF A MINIATURIZED REFRIGERATOR FOR SPACE APPLICATIONS
[1963] 230 p 12 refs
(Contract AF 04(695)-144)
(SSD-TDR-63-243)

Study was undertaken to develop an experimental cooling device having an ultimate life of three years continuous, unattended operation in a satellite environment with an internal temperature variable from 273° to 300° K and a cooling capacity of 2 watts at a temperature of 77° ±7° K, measured at the cold fluid terminals of the refrigerator, with maximum power input of 100 watts of electrical power. The volume is not to exceed 610 cubic inches, length not more than 24 inches, diameter not more than 8 inches, and the weight not more than 15 pounds. Ability is desired of the system to cool infrared detector arrays and tubes without significantly degrading their noise characteristics from those realized by immersing them in liquid nitrogen at atmospheric pressure, and adaptability to space radiators is required for the rejection of internally generated heat. A breadboard model refrigerator was built and it was concluded that, with improvements in the basic design and with the development of better processes for fabricating components and materials needed, a reliable refrigerator for space application can be developed. C.L.W.

N63-20823 Naval Radiological Defense Lab., San Francisco, Calif.
THERMAL DIFFUSIVITY MEASUREMENTS ON METALS AND CERAMICS AT HIGH TEMPERATURES [Final Report, Feb. 27-Dec. 19, 1962]
R. L. Rudkin Wright-Patterson AFB, Ohio, AF Materials Lab., June 1963 22 p 13 refs
(Contract AF 33(657)-2-RD-155)
(ASD-TDR-62-24, Pt. II)

The U.S. Naval Radiological Defense Laboratory flash method of measuring thermal diffusivity has been extended to ceramics at high temperatures. Several problems encountered in applying this technique to ceramics are discussed: heating the samples to a uniform temperature over the sample face; overcoming the transparency of the specimens to the radiation from the xenon flash lamp; and correcting for radiation heat losses from low thermal-conductivity ceramic specimens at higher temperatures. Measurements of the thermal diffusivity of the following materials are reported up to the temperatures indicated: Pyroceram No. 9606 (1160° C), Pyroceram No. 9608 (1210° C), Pyroceram No. 9690 (1150° C), beryllium oxide (1780° C), aluminum oxide (four types) (1730° C), magnesium oxide (two types) (1370° C), and two spinels (1630° C). Heat capacity data have been obtained on Pyroceram No. 9608 between room temperatures and 650° C. Author

N63-20841 Lockheed Missiles and Space Co., Sunnyvale, Calif. Mathematical and Mechanical Sciences Lab.
THERMOPHYSICS DESIGN HANDBOOK
R. E. Gaumer July 1963 110 p 26 refs
(Contracts AF 04(647)-787 and AF 04(695)-136)
(LMSC-8-55-63-3; Encl. to LMSC-A337475)

A thermophysics design handbook is presented which contains the design data and information required for the specification of thermal design materials on the basis of their thermophysical properties and for the stability and predictability of these properties in the total spacecraft environment. Materials described are limited to those approved as thermal control materials and are based on the following criteria: (1) The material exhibits properties and environmental stability required for spacecraft thermal control. (2) The material fulfills requirements dictated by space-vehicle design which are not presently fulfilled by other approved thermal-control materials. (3) A capability for reproducible production of the material exists. Parameters affecting the thermal behavior of a surface are described; the effects of the spacecraft environment are discussed; and the experimental methods used to obtain design data are presented. P.V.E.

N63-20960 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FORCED CONVECTION IN A CHANNEL WITH WALL HEAT CAPACITY AND WITH WALL HEATING VARIABLE WITH AXIAL POSITION AND TIME
Robert Siegel Repr. from Intern. J. of Heat and Mass Transfer, v. 6, 1963 p 607-620 9 refs
(NASA RP-4)

Heat transfer to a fluid with constant properties is analyzed for forced convection between two parallel plates. The plates have a finite heat capacity, and heat is supplied to them in an arbitrary manner with both time and axial position. The wall is assumed sufficiently thin or highly conducting so that the temperature variation through the wall thickness can be neglected. The fluid temperature is variable over the channel cross section, but the fluid velocity is assumed constant throughout the channel (slug-flow condition). The energy

equation is laminar. A general method of solution is given, and illustrative examples are carried out. These include uniform wall heating that varies sinusoidally in time, and heating varying sinusoidally with axial distance and exponentially in time. Author

N63-20997 National Bureau of Standards, Washington, D.C.
TABLES OF THERMODYNAMIC PROPERTIES OF AIR IN CHEMICAL EQUILIBRIUM INCLUDING SECOND VIRIAL CORRECTIONS FROM 1500°K to 15,000°K
Joseph Hilsenrath and Max Klein Arnold Eng. Develop. Center, Aug. 1963 207 p 49 refs
(Delivery Orders AF 40(600)59-24 and AF 40(600)63-136)
(AEDC-TDR-63-161)

Tables of the thermodynamic properties of air are presented which take into account the effect of dissociation and ionization, the Debye–Hücker limiting-law, and second virial corrections, upon thermodynamic properties and equilibrium compositions. The underlying equations and the input data are discussed briefly. The effects of the real-gas corrections on the equilibrium properties are illustrated graphically. The equilibrium composition is given for selected temperatures over the tabulated density range. The wide range of temperatures and densities given makes the tables useful in a variety of engineering design and test programs, and in scientific research and development. Author

N63-21012 General Dynamics/Fort Worth, Tex.
PROCESS CONTROL – EFFECTS OF AUSTENITE CONDITIONING 17-7 PH AT 1200°F ON MECHANICAL PROPERTIES Test Report Feb. 27, 1961-June 9, 1961
W. A. Token Aug. 5, 1963 10 p
(Contract AF 33(657)-11214)
(PCTR-4594)

Heat treatment of 0.010-in. to 0.250-in. thicknesses of 17-7 PH at the austenite conditioning temperature of 1200° F, and using either 900° F or 1050° F precipitation temperatures, produced a greater deviation of mechanical properties as compared with the values obtained by the use of 1400° F conditioning temperature. There was produced a maximum 20 to 25 KSI difference between the 0.010-in. and 0.250-in. thicknesses. The 0.050-in. thickness material used in this test produced consistent, low, mechanical properties (yield strength and ultimate tensile strength) in relationship to the other thicknesses, but these properties were well above the minimum requirements. The 0.150-in. and 0.250-in. thicknesses mechanical properties were lower (except elongation) with relation to the other thicknesses used. The elongation values were much higher than the elongation of the other thicknesses, four to five percent increase. The elongation values of the 0.010-in. thickness were just below the minimum requirements. Closer control of measurement and/or closer control of heat treatment should produce the acceptable elongation values. Austenite conditioning of 17-7 PH stainless steel material at 1200° F in lieu of the standard 1400° F will produce acceptable mechanical properties. Author

N63-21017 Los Alamos Scientific Lab., N. Mex.
TEMPERATURE-FLOW STABILITY EXPERIMENTS
F. A. Guevara, B. B. Mc Inteer, and R. M. Potter Aug. 30, 1963 50 p 1 ref
(Contract W-7405-eng-36)
(LAMS-2934) OTS: $1.25

The results of this experimental investigation give conclusive evidence that temperature-flow instability occurs in a system which has helium flowing through a uniformly heated channel if there is an increase in the gas temperature by a factor of 3.6 or more. This instability occurs for values of ΔP and Q corresponding to the region of negative slope on a steady-state pressure drop versus flow diagram. When a plenum precedes the channel the instability appears as sustained oscillations if an attempt is made to operate the system in the unstable region. The recorded observations of this behavior are discussed in detail. The final observation reported is that temperature-flow instability can be overcome by the addition of an introductory impedance to the system. Author

N63-21215 Electro-Optical Systems, Inc., Pasadena, Calif.
AN ANALYSIS OF A BASE HEAT TRANSFER IN LAMINAR FLOW
Hartley H. King Sept. 1963 43 p 9 refs
(Contract DA-04-495-AMC-28-(Z); ARPA Order 203-A1-63; Proj. Defender)
(EOS-RN-14)

The laminar, separated base-flow model of Chapman has been extended to obtain a solution for the recirculating flow field and the heat transfer to the base. New heat-transfer-coefficient data applicable to two-dimensional and axisymmetrical bodies with flat bases are presented in tabular and graphical form. Sample calculations for typical bodies at reentry and wind-tunnel conditions suggest that the total base heat transfer is roughly 2×10^{-3} of the total heat transfer to the vehicle, depending weakly on the flight Reynolds number. Author

N63-21319 Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
TEMPERATURE DISTRIBUTION IN LONG CYLINDRICAL FUEL ELEMENTS COOLED INTERNALLY BY SEVERAL CHANNELS
D. E. Amos and F. R. Zaloudek May 1963 25 p
(Contract AT(45-1)-1350)
(HW-77681) OTS: $0.75

Analytical relationships were developed to express the cross-section temperature distribution in cylindrical fuel elements cooled internally by longitudinal cooling channels. Using the concept of sources and sinks, the heat conduction equation for an isotropic solid with radially distributed heat sources was solved for the fuel configurations under consideration. Temperature distribution equations are presented for both a generalized radial distribution of heat generation and a radial heat generation distribution developed from the neutron diffusion theory. These analytical relationships were applied to a typical problem to demonstrate their usefulness in the evaluation of the thermal characteristics of internally cooled fuel elements. Author

14 HUMAN BEHAVIOR

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: 10 Facilities.

For related information see: 16 Life Sciences.

N63-20693 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
THE EFFECTS OF PROLONGED WATER IMMERSION ON THE ABILITY OF HUMAN SUBJECTS TO MAKE POSITION AND FORCE ESTIMATIONS

Donald A. Morway, Richard G. Lathrop, Randall M. Chambers, and Lloyd Hitchcock, Jr. July 24, 1963 26 p 5 refs (NADC-MA-6115; Bur. of Med. and Surg. Rept. 5)

Twelve subjects using underwater breathing apparatus were immersed in water for 18 hours. Each subject's responses to two general psychomotor tasks—(1) the ability to reach and position the arm and hand accurately, and (2) the ability to estimate a prelearned level of force—were measured before, during, and after water immersion. Analysis of variance performed upon the target-aiming task showed no significant difference in the horizontal aiming component. However, a highly significant ($p < 0.01$) bias upwards was observed in the vertical aiming component. Comparisons between trial means, using the Duncan q' test, indicate that the bias upwards declined as a function of immersion time. An analysis of variance performed upon the force estimation data showed a significant interaction between trials within blocks and test conditions. Duncan's q' Test Ordered Means Comparison revealed no significant difference between the preimmersion and postimmersion force estimations. The mean estimation obtained during immersion was significantly different ($p < 0.01$) from the pretrial and posttrials. The force data showed no tendency to adapt as a function of time immersed. Author

N63-20694 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.

EFFECTS OF TRANSVERSE ACCELERATION ON PERFORMANCE OF TWO RUNNING MATCHING MEMORY (RMM) TASKS

Bruce M. Ross, Randall M. Chambers, and Richard R. Thompson May 29, 1963 46 p 14 refs
(Contract N62269-1203 and N62269-1525)
(NADC-MA-6309; Bur. Med. and Surg. Rept. No. 9)

The present investigations were undertaken to study the nature of degradation in higher mental functioning which might be produced by exposure of man to transverse G. A running matching memory (RMM) task was selected to study the higher mental functioning. This task involved sequential comparisons of "same" or "different" for a present symbol, with a symbol occurring at a fixed interval (1-back, 2-back, 3-back, etc.) before the viewed symbol. A second experiment was performed on the centrifuge using a single RMM condition with four different G levels (3, 5, 7, and 9 G). The RMM task in the second experiment involved matching in two channels (1-back "same" or "different" for randomized +s and −s displayed on the right). Subjects had only 2.75 seconds to perform both matches, making a total duration per centrifuge run of 2 minutes and 18 seconds, compared to a run duration of 4 minutes and 10 seconds for conditions in the first experiment. Author

N63-21133 National Aeronautics and Space Administration, Washington, D.C.

THE HUMAN FACTOR IN MANNED SPACE FLIGHT

David H. Stoddard *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 67–71 (See N63-21126 21-01)

Activities carried out in support of the human occupant of a spacecraft are reviewed. These are: (1) development, test, and evaluation of components and systems required to ensure man's survival and safe effective performance in spaceflight, and (2) the operational medical support incident to the selection and maintenance of flight crews, their preparation for flight, surveillance during flight, and evaluation upon termination of flight. It is indicated, to date, that: (1) man has demonstrated his ability to take spaceflight in stride; (2) it has been possible, by means of flight experience, to validate the concepts on which present life-support systems were based; (3) peculiar phenomena of the space environment, such as the weightless state, have not proven to be serious problems, and an acceptable degree of reliability in the components of life-support systems have been developed. I.v.L.

15 INSTRUMENTATION

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N63-20775 Federal Aviation Agency, Atlantic City, N.J.

COMPARATIVE EVALUATION OF AUSTRALIAN TVG AND UNITED STATES STANDARD VISUAL APPROACH SLOPE INDICATORS Final Report

M. L. Hyman July 1963 56 p

Flight tests were conducted to compare the Australian "Tee" Visual Approach Slope Indicator with the United States Standard "Red-White" Visual Approach Slope Indicator. A significant majority of the pilots preferred the Australian "Tee" System. Phototheodolite recordings showed that the "Tee" System provided more precise and accurate guidance than the "Red-White" System. Pilot comments indicated, however, that the "Tee" System did not provide a satisfactory undershoot indication, and that a failure of the fly-up or fly-down units of the system may be be recognized. Pilots also noted that the base leg guidance of the "Tee" System was inferior to the "Red-White" System. Alignment of the "Tee" System components was more critical than that of the "Red-White" System. Recommendations were made for further development of the "Tee" System, and that an evaluation of the improved system be conducted. Author

N63-20803 Wissenschaftliche Gesellschaft für Luftfahrt, Cologne (W. Germany)

AERODYNAMIC MEASURING TECHNOLOGY. PROCEEDINGS OF THE [FIRST] MEETING OF THE SUBCOMMITTEE ON AERODYNAMIC MEASURING TECHNOLOGY, APRIL 26, 1962 AACHEN [AERODYNAMISCHE MESSTECHNIK. BERICHT UBER DIE SITZUNG DES UNTERSUCHSCHUSSES AERODYNAMISCHE MESSTECHNIK]

Alfred Heyser et al [1962] 226 p 147 refs In GERMAN
(WGL Ber.-5/1962)

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2. PRESSURE MEASURING DEVICES IN SUPERSONIC WIND TUNNELS A. Heyser (Deut. Versuchsanstalt für Luft- u. Raumfahrt, Aachen) p 16–45 20 refs (See N63-20805 21-15)

3. PRESSURE PROBES USED IN AERODYNAMIC RESEARCH TECHNOLOGY W. Wuest (Aerodynamische Versuchsanstalt, Göttingen) p 46–94 83 refs (See N63-20806 21-15)

4. MACH NUMBER MEASUREMENT IN HIGH-SPEED WIND TUNNELS E. Stanewsky (Deut. Versuchsanstalt für Luftfahrt, Aachen) p 95–146 14 refs (See N63-20807 21-15)

5. PRESSURE-DISTRIBUTION MEASUREMENTS BY INLET FLOW INVESTIGATIONS A. Ehrismann (Messerschmitt A.G., Augsburg) p 147–155 (See N63-20808 21-15)

6. MEASUREMENT OF THE TURBULENT WALL SHEARING STRESS I. Rechenberg (Tech. U., Berlin) p 156–188 25 refs (See N63-20809 21-15)

7. ON A TIME-SAVING EXPERIMENT FOR SPEEDVECTOR-MEASURING R. Ramshorn (ISL, St. Louis) p 189–195 (See N63-20810 21-15)

8. FLOW DIRECTION PROBER IN COMBUSTION CHAMBERS F. v. Burger-Scheidlin (Deut. Versuchsanstalt für Luftfahrt, Brunswick) p 196–216 (See N63-20811 21-15)

N63-20804 Deutsche Versuchsanstalt für Luftfahrt, Porz (W. Germany) Inst. für Angewandte Gasdynamik

PRESSURE MEASURING DEVICES FOR USE IN SUBSONIC WIND TUNNELS [DRUCKMESSGERATE FUR MESSUNGEN IN UNTERSCHALLWINDKANALEN]

H. Fabian *In* Wiss. Ges. für Luft- u. Raumfahrt, Cologne (W. Germany) Aerodynamic Meas. Technol. Proc. of the Meeting of the Subcomm. on Aerodynamic Meas. Technol. Aachen, Apr. 26, 1962 p 1–15 5 refs In GERMAN (See N63-20803 21-15)

Descriptions, advantages, and disadvantages of the following pressure-measuring instruments are presented. (1) A U-tube manometer which measures pressure difference without calibration; (2) an unequal-sided manometer where the cross section of one leg is so large compared to the other leg that the meniscus can be ignored; (3) a micromanometer which measures pressure differential from 0.1 to 200 mm (water column); (4) a water-column minimeter where the difference in the levels of the two liquid surfaces corresponds to the differential pressure; (5) the Betz manometer which is in principle similar to the unequal-sided manometer, except that the leg with the smaller diameter dips into the leg with the larger diameter; and (6) a multimanometer which has a useful measuring length of 1700 to 1880 mm, with a possible reading accuracy to ±0.5 mm. I.v.L.

N63-20805 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany) Inst. für Angewandte Gasdynamik

PRESSURE MEASURING DEVICES IN SUPERSONIC WIND TUNNELS [DRUCKMESSGERATE FUR MESSUNGEN IN UBERSCHALLWINDKANALEN]

A. Heyser *In* Wiss. Ges. für Luft- u. Raumfahrt, Cologne (W. Germany) Aerodynamic Meas. Technol. Proc. of the Meeting of the Subcomm. on Aerodynamic Meas. Technol., Aachen, Apr. 26, 1962 p 16–45 20 refs In GERMAN (See N63-20803 21-15)

Pressure measurements in supersonic wind tunnels are reviewed. The measuring conditions peculiar to a supersonic wind tunnel require, for the most part, electronic instruments. Short operating time of the entire measuring equipment must be achieved, as well as proper contact conditions. A survey is presented of the various pressure-measurements equipment which is used in various test installations. A large number of measuring points are required for pressure-distribution measurements. A suitable pressure-measuring point selector switch would result in a decided decrease in expenditures for apparatus. Very small pressure gages, which can be installed in model wind tunnels are necessary for measuring rapid change in pressure per unit time. Special calibration equipment should be set up for calibrating the gage. Trans. by I.v.L.

N63-20806 Aerodynamische Versuchsanstalt, Göttingen (W. Germany)

PRESSURE PROBES USED IN AERODYNAMIC RESEARCH TECHNOLOGY [DRUCKMESSONDEN IN DER AERODYNAMISCHEN VERSUCHSTECHNIK]

W. Wuest *In* Wiss. Ges. für Luft- u. Raumfahrt, Cologne (W. Germany) Aerodynamic Meas. Technol. Proc. of the Meeting of the Subcomm. on Aerodynamic Meas. Technol., Aachen, Apr. 26, 1962 p 46–94 83 refs In GERMAN (See N63-20803 21-15)

The pressure characteristics in both subsonic and supersonic flow are discussed and determined. Also discussed are: (1) various designs of Pitot tubes, static-pressure probes, dynamic-pressure probes, and flow-direction probes; and (2) the error effects of flow direction, pressure gradient, wall, viscosity, Mach number, and degree of turbulence on these instruments. Trans. by I.v.L.

N63-20807 Deutsche Versuchsanstalt für Luftfahrt, Aachen (W. Germany). Inst. für Angewandte Gasdynamik

MACH NUMBER MEASUREMENT IN HIGH-SPEED WIND TUNNELS [MACHZAHLMESSUNG IN HOCHGESCHWINDIGKEITSWINDKANALEN]

E. Stanewsky *In* Wiss. Ges. für Luft- u. Raumfahrt, Cologne (W. Germany) Aerodynamic Meas. Technol. Proc. of the Meeting of the Subcomm. on Aerodynamic Meas. Technol., Aachen, Apr. 26, 1963 p 95–146 14 refs In GERMAN (See N63-20803 21-15)

The Mach number in high-velocity wind tunnels is reviewed. The Mach number is the most important similitude parameter and the accuracy of the determination of the aerodynamic values, such as lift and drag coefficients, are more dependent upon the accuracy of the free-stream Mach number than upon any other parameter. A diagram is presented of the error in aerodynamic values as a function of the Mach number, which appears when the Mach-number error is 1%. At a Mach number of $M \geq 5$, the error is about 5%. The error is particularly large in the transonic range. The possibilities and methods of determining the Mach number with the aid of different parameters (pressure, density, temperature, velocity, or wave geometry) are described. Along with calculated relationships between the Mach number and measurable magnitudes, measurement probes are discussed. Mach-number measurements in the wind tunnels of the Institute of Applied Gas Dynamics of the DVL are illustrated. Also, errors are considered which were due to deviations from the given flow conditions. I.v.L.

N63-20808 Messerschmitt A.G., Augsburg (W. Germany)

PRESSURE-DISTRIBUTION MEASUREMENTS BY INLET FLOW INVESTIGATIONS [DRUCKVERTEILUNGSMESSUNGEN BEI EINLAUFUNTERSUCHUNGEN]

A. Ehrismann *In* Wiss. Ges für Luft- u. Raumfahrt, Cologne (W. Germany) Aerodynamic Meas. Technol. Proc. of the Meeting of the Subcomm. on Aerodynamic Meas. Technol., Aachen, Apr. 26, 1962 p 147–155 In GERMAN (See N63-20803 21-15)

Pressure-distribution measurements on engine compressor inlets are discussed. From a simplicity-of-apparatus standpoint, these measurements may be made by the following three methods: (1) the use of a large number of probes permanently installed in the wind tunnel—disadvantages of this arrangement are the obstruction of flow and the mutual interference of the probes; (2) the use of a single probe which can be shifted continuously or stepwise at the level of the compressor inlet—this method is time-consuming; and (3) the use of a combination of (1) and (2), i.e., a fixed number of probes at the compressor inlet. Also discussed is a method for decreasing the

amount of time and the number of people required for computing pressure-distribution measurements. This method consists of the application of a half-automatic computing unit whereby an indicator or a lineal is set at the measured value. A button or a pressure foot pedal takes care of punching the tapes or the cards. (Several of these units are on the market.) With such a unit, 600 values per minute can be processed by one person which is ten times more than can be processed without half-automation. I.v.L.

N63-20809 Technische U., Berlin (W. Germany)
MEASUREMENT OF THE TURBULENT WALL SHEARING STRESS [MESSUNG DER TURBULENTEN WANDSCHUB-SPANNUNG]
I. Rechenberg *In* Wiss. Ges. für Luft- u. Raumfahrt, Cologne (W. Germany) Aerodynamic Meas. Technol. Proc. of the Meeting of the Subcomm. on Aerodynamic Meas. Technol., Aachen, Apr. 26, 1962 p 156–188 25 refs In GERMAN (See N63-20803 21-15)

The difficulty of experimentally determining the local surface shearing stress of a friction layer is discussed. A new method, which eliminates many of the errors of previous methods, was developed for measuring turbulent skin friction. This new method emphatically acknowledges the accuracy of the Preston tube for surface friction measurements, as well as the outstanding validity of a universal law of surfaces for various turbulent friction layers. The first result obtained by the new method, during an investigation of a turbulent boundary layer, was the detection of unexpected and regular friction-layer variations which occurred perpendicular to the flow. I.v.L.

N63-20810 Institut Franco-Allemand de Recherches, St. Louis (France)
ON A TIME-SAVING EXPERIMENT FOR SPEEDVECTOR-MEASURING [UBER EIN ZEITSPARENDES VERFAHREN ZUR MESSUNG DES GESCHWINDIGKEITSVEKTORS]
R. Ramshorn *In* Wiss. Ges. für Luft- u. Raumfahrt, Cologne (W. Germany) Aerodynamic Meas. Technol. Proc. of the Meeting of the Subcomm. on Aerodynamic Meas. Technol., Aachen, Apr. 26, 1963 p 189–195 In GERMAN (See N63-20803 21-15)

A time-saving method for measuring velocity vectors is described. This method is based on the principle of continuous measurements. The assembly for measuring the velocity field behind an airplane wing consists of the probe and support with the beryllium-bronze "siphon" membranes. The probe support and membranes are attached to a remote-control positioning apparatus. The assembly also consists of a switch box with registers for the three coordinates of the probe and for the three "Speedomaxen." Circulation measurements can also be conducted by remote control. A comparison of the point-by-point measurements of the tangential components in circulation measurements, by means of U-tubes with continuous measurements of a series of 24 measurement points of 15° each along the circumference, showed a time-measurement relationship of 30:1 minutes. The continuous measurements are presented in the form of a curve. Besides being time saving, the continuous method gives intermediate values. Results are presented in graphic form, of the following continuously measured velocity components: (1) the radial and tangential components along the circumference of a concentric circle at the vortex center at various distances behind a rectangular wing, and (2) the vertical component along a line which passes through both vortices at a distance of nine wing chords behind the same wing. I.v.L.

N63-20811 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany)
FLOW DIRECTION PROBER IN COMBUSTION CHAMBERS [RICHTUNGSSONDEN IN BRENNKAMMERN]
F. v. Burger-Scheidlin *In* Wiss. Ges. für Luft- u. Raumfahrt, Cologne (W. Germany) Aerodynamic Meas. Technol. Proc. of the Meeting of the Subcomm. on Aerodynamic Meas. Technol., Aachen, Apr. 26, 1962 p 196–216 In GERMAN (See N63-20803 21-15)

A water-cooled probe for flow direction measurements was developed. This probe also permits inferences as to flow magnitude. Slight modifications of the probe, which should be made according to the special research problem at hand, make it applicable to flow measurements in combustion chambers of jet engines. The construction of a calibration tunnel for high flow velocities and high temperatures is planned at the DFL for the purpose of conducting these measurements. This tunnel can be used for the calibration of all pressure and temperature sensors. Also, the tunnel can be used for the investigation of the flow around pressure and temperature sensors. Trans. by I.v.L.

N63-21027 Naval Ordnance Test Station, China Lake, Calif.
TEST AND EVALUATION OF A PILOT WARNING INDICATOR
J. J. Adler Jan. 1963 24 p 1 ref
(NOTS-TP-3102; NAVWEPS-8080)

Ground and inflight measurements of the system's performance were obtained. Test results and recommendations for improvement of the equipment are presented. Author

N63-21160 Army Missile Command, Huntsville, Ala. Army Inertial Guidance and Control Lab.
LOW COST ACCURATE SENSOR (AB-30) Design Status Report
W. E. Grunwald July 23, 1963 15 p
(RG-TR-63-22)

A study has been made at the Army Inertial Guidance and Control Laboratory to determine what design characteristics and parameters must be followed to design and manufacture a moderate-cost and moderate-precision stability-sensing gyroscope. Various materials have been checked and tested for possible use in the manufacture of the gyro rotor, sensing elements, and gyro case. Basic comparisons are tabulated and presented in this report. Author

N63-21223 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
POPPY PHOTOFLASH CARTRIDGE ASSEMBLY
A. J. Neigh and A. J. White, Jr. July 1962 23 p
(Notes on Development Type Materiel 262)

The Poppy photoflash cartridge is a high-performance pyrotechnic device designed to produce short-duration flashes suitable for being photographed at extreme ranges and altitudes. The Poppy photoflash cartridge assembly has a maximum length of 5.13 inches, with a maximum diameter of 2.98 inches. The housing end of the assembly incorporates a 3.98-inch-diameter flange for bulkhead-type mounting, with provisions for attachment with six No. 10—100° machine screws. The complete assembly weighs approximately 1.75 pounds, not including the mounting hardware. A description is presented of assembly tools, preparation and installation, performance characteristics, and precautions for handling and storage. P.V.E.

N63-21248 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
WAVE SUPERHEATER HYPERSONIC TUNNEL Semi-Annual Report, July 1, 1961-Jan. 1, 1962
J. E. Carpenter Arnold Eng. Develop. Center, Tenn. [1962] 75 p 7 refs
(Contract AF 40(600)-804; ARPA Order 86-59; Proj. Defender) (CAL-AD-1345-W-7; AEDC-TDR-62-54)

Included is a brief description of the installation and the principle of operation of the wave-superheater hypersonic tunnel. The status of the shakedown and calibration of the superheater and tunnel systems, now in progress, is described. Author

16 LIFE SCIENCES

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

N63-20696 Joint Publications Research Service, Washington, D.C.
CONCERNING THE PROBLEM OF THE COMBINED EFFECT OF A HIGH-FREQUENCY ELECTROMAGNETIC FIELD AND X-RAY IRRADIATION UNDER INDUSTRIAL CONDITIONS
Yu. A. Osipov et al Aug. 30, 1963 9 p Transl. into ENGLISH from Gigiena i Sanit. (Moscow), v. 28, no. 6, June 1963 p 35–38
(JPRS-20872; OTS-63-21658) OTS: $0.50

A syndrome of pathological changes due to the combined effect of high-frequency electromagnetic fields and X-ray irradiation on the human being, under industrial conditions, is discussed. The chief components of this syndrome consist of complaints of weakness, sleepiness, headaches, pains in the region of the heart, arthralgia, and functional disorders of the central nervous system. The syndrome begins to disappear with complete or partial removal of one of the causative factors. C.L.W.

N63-20714 Joint Publications Research Service, Washington, D.C.
TWENTY-FOUR HOUR PERIODICITY OF MITOSES IN MICE FOLLOWING THE ACTION OF GAMMA RAYS
L. P. Kosichenko Aug. 21, 1963 8 p 8 refs Transl. into ENGLISH from Byull. Eksptl. Biol. i Med. (Moscow), v. 55, no. 1 Jan. 1963 p 114–117
(JPRS-20735; OTS-63-31585) OTS: $0.50

A study was made of the effect produced by ionizing radiation (190 and 400 r) on the 24-hour periodicity of mitotic activity of the mouse corneal epithelium. The time of the maximal and minimal number of mitoses coincided with control indices. The range of the 24-hour variations in the number of mitoses showed no significant change in the experimental animals. After irradiation of mice with a dose of 400 r, there was a rise in the mean 24-hour intensity of cellular multiplication. Author

N63-20735 Atomic Energy of Canada Ltd., Chalk River, Ontario
A RAPID SPECTROGRAPHIC METHOD FOR THE DETERMINATION OF BERYLLIUM ON FILTER PAPER
G. J. Jarbo and G. Zotov May 1963 10 p
(CRDC-1157; AECL-1809) AEC of Canada: $0.50

Because beryllium is very toxic, rapid analytical techniques are needed to ensure that health hazards arising from its use in the laboratory are fully under control. In the past, samples on filter paper from air and surface sampling were analyzed by ashing, dissolving, and sparking a dried residue. A method has now been developed for sparking the filter paper directly, using a previously incorporated cobalt standard. The filter paper is mounted on a disc-shaped electrode that is rotated and shifted back and forth beneath a fixed electrode so that the whole surface of the paper is explored. Beryllium can readily be determined at levels significantly below those that indicate a health hazard. Time required for analysis is about ten minutes. Author

N63-20744 Joint Publications Research Service, Washington, D.C.
ELECTRONICS AND MEDICINE
Ye. B. Babskiy Sept. 6, 1963 56 p 15 refs Transl. into ENGLISH of the introductory sect. of book "Elektronyka dlya biologov i medikov" Moscow-Leningrad, 1962 p 9–70
(JPRS-20968; OTS-63-31701) OTS: $1.50

Electronics and electrical devices are discussed in terms of their use in the field of medicine. Electronics is used in collecting information about body processes occurring in the body, for automatic analysis of this information, to provide electrical stimulation of body tissues, which in turn, changes a number of their parameters at the desire of the investigator allowing further diagnosis, for modelling various processes that occur in the body and for electronic control of activity processes and automatic regulation of the organism environment. Electronic stethoscopes, micropressure transducers, sphygmographs, electroencephalography, electromyography and various other electronic equipment and techniques are discussed. C.L.W.

N63-20754 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
SELECTION OF SPACE CABIN ATMOSPHERES. PART I: OXYGEN TOXICITY
Emanuel M. Roth Washington, NASA, Aug. 1963 94 p 177 refs
(NASA Contract NASr-115)
(NASA TN-D-2008) OTS: $2.25

The pertinent molecular mechanisms of oxygen toxicity are discussed in light of current free-radical concepts. Specific effects of high oxygen tension in both experimental animals and man are then reviewed for the range of 0.2 to 1.0 atm. Effects of higher oxygen tensions are covered only where they shed light on the pathological mechanism expected in the space-cabin environment. The associated oxygen problems of radiation pathology are then analyzed. A final review is made of information gaps and areas for future study which will aid in selection of space cabin systems. Author

N63-20793 Aerospace Information Div., Library of Congress, Washington, D.C.
SOVIET LITERATURE ON LIFE SUPPORT SYSTEMS A. BIOSCIENCES
Aug. 22, 1963 26 p 8 refs
(*Its* Rept. 16; AID Work Assignment 22; AID P-63-108) OTS: $2.60 ph, $0.98 mf

This report on life-support systems covers the following: space medicine and biology; space physiology; perceptual physicology; space psychology; space-vehicle ecology; and survival conditions. J.R.C.

N63-20928 Joint Publications Research Service, Washington, D.C.
THE BIRTH OF COSMIC BIOLOGY
V. V. Parin Mar. 14, 1963 6 p Transl. into ENGLISH of an article from Priroda (Moscow), v. 51, no. 10, 1962 p 9–11 (JPRS-18125 OTS-63-21321); OTS: $0.50

A short survey of the basic stages in the development of Soviet cosmic physiology is presented, and shows that a wide comparative-biological approach to the comprehensive evaluation of the effects of the factors of cosmic flight on living organisms, was the basis for responsible conclusions regarding the possibilities and opportunities of cosmic flight for man. The basic scientific results of the cosmonauts flights are proofs of the complete possibility of man's remaining is cosmic space up to 95 hours without interrupting the operating capabilities and normal state of the basic physiological functions. P.V.E.

N63-20935 National Aeronautics and Space Administration, Washington, D.C.
THE SEARCH FOR EXTRATERRESTRIAL LIFE
23 p
(NASA EP-10) GPO: $0.20

The following are the techniques and instruments being used in the search for extraterrestrial life: (1) optical dispersion rotary profile for determining the presence of deoxyribunucleic acid (DNA), (2) a multivator for detecting microscopic life in soil samples, (3) a vidicon microscope for examining Martian atmospheric dust, (4) J-band experiments for determining protein content of dust, (5) a radioisotope biochemical probe for detection of the presence of bacteria, (6) mass spectrometer for determination of amino acids, (7) a Wolf Trap for developing bacteria cultures, and (8) an ultraviolet spectrophotometer for identifying organic compounds by their absorption spectra. E.K.R.

N63-21109 National Research Corp., Cambridge, Mass.
EXPOSURE OF MICROORGANISMS TO SIMULATED EXTRATERRESTRIAL SPACE ECOLOGY
Gerald S. Silverman, Norman S. Davis (MIT), and Wayne H. Keller [1963] 25 p 12 refs Presented at the Cospar 6th Plenary Meeting and 4th Intern. Space Symp., Warsaw, June 3–12, 1963
(NASA Contract NASr-41)
(NASA CR-51102) OTS: $2.60 ph, $0.95 mf

The viability of spores of 5 test organisms (*B. megaterium*, *B. subtilis* var. *niger*, *B. stearothermophilus*, *Clostridium sprogenes*, and *A. niger*) after exposure to a wide range of temperatures, or to gamma radiation, while under ultrahigh vacuum was investigated. An appreciable percentage of all the test organisms were viable after exposure to temperature up to and including 60° C, and a small portion of the exposed spores were still viable after exposure to 107° C but not to 120° C. With the exception of *B. subtilis* var. *niger*, ultrahigh vacuum appeared to protect the spores, especially *A. niger*, subjected to prolonged exposure to elevated temperatures in the vicinity of 90° C. A sample of local soil and one obtained from the Mohave desert were also subjected to temperature-vacuum experiments. The soil samples were examined at various temperatures at ultrahigh vacuum. Local soil showed quantitative recovery of mesophilic aerobes, mesophilic anaerobes, and actinomycetes but no molds at temperatures up to 100° C; at higher temperatures, mesophilic aerobes, molds, and actinomycetes were recovered. Forty-three typical isolates were recovered from the Mohave desert soil after being subjected to 120° C for 4 to 5 days at 6×10^{-9} torr. P.V.E.

N63-21184 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
IMPORTANCE OF STOMACH AND OTHER EXTRATHYROIDAL EXTRARENAL AVENUES OF IODIDE LOSS DURING THYROID UPTAKE TESTS
William P. Fife June 1963 22 p 51 refs
(*Its* Review 6-63)

Extrathyroidal, extrarenal distribution of iodide and an assessment of the effect of this distribution on thyroid uptake studies are reviewed. Although the thyroid gland and the kidneys are considered the two main organs in direct competition for blood iodide, there are actually at least seven other organs, each of which, during the first two hours after iodide administration, may remove more iodide than does the thyroid gland itself. These organs are the stomach, bone and muscle, skin, liver, gut, lungs, and heart. Even at the end of eighteen hours, the thyroid gland may accumulate only 20% of the radioactive iodide found in the body at that time. Thyroid uptake tests employing radioactive iodide may be grossly influenced by the stomach, which normally accumulates iodide actively at a high organ/blood gradient. Certain conditions, such as vomiting and aspiration, may result in removal of an exceedingly large amount of the iodide test dose before it can be accumulated by the thyroid gland. Under other conditions, such as achlorhydria or gastrectomy, the stomach may hold little iodide, resulting in blood concentrations of iodide remaining higher than normal, thus permitting the thyroid to remove more iodine than normally. Any combination of these conditions probably would seriously influence thyroid uptake studies. It would seem that careful consideration of the role which the stomach plays in iodide distribution would be especially important where a borderline thyroid gland is being evaluated. I.v.L.

N63-21185 Texas Nuclear Corp., Austin
DEVELOPMENT OF AN APPARATUS FOR PARTIAL CELL IRRADIATION
Ira L. Morgan, Loy D. England, Robert L. Launer, William E. Tucker, Joseph S. Pizzuto, and Charles M. Pomerat (Pasadena Found. for Med. Res.) Brooks AFB, Tex., AF School of Aerospace Med., June 1963 15 p 9 refs
(Contract AF 14(657)-291)
(SAM-TDR-63-26)

An apparatus has been developed which allows 16 mev proton irradiation of selected areas of single, living, biologic cells cultured in vitro. The highly collimated proton microbeam passes through the tissue culture and is monitored as to number and energy of protons. Extrapolation of individual proton energies allows determination of the energy loss in the tissue. Specific advances over earlier work in partial cell and microbeam irradiation include the collimation of 16 mev protons, cellular alignment technique, and special monitoring methods. Author

N63-21186 Joint Publications Research Service, Washington, D.C.
IMPORTANT DEVELOPMENTS IN BIOLOGICAL SCIENCES. MEDICAL AND BIOLOGICAL RESEARCH ON THE FACTORS IN SPACE FLIGHT
Yu. M. Volynkin and P. P. Saksonov Sept. 6, 1963 21 p 26 refs Transl. into ENGLISH of an article from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 3, 1963 p 405–418 (JPRS-20943; OTS-63-31684) OTS: $0.75

An analysis of existing data on the biological effects of physical conditions in spaceflight, and an examination of certain problems of the protection of living organisms against the damaging effect of certain factors in spaceflight are presented. Factors discussed are: (1) those which characterize

space as a unique external habitat environment for living organisms (the vacuum of space, altered gas composition, radiation, etc.); (2) those connected with the dynamics of rocket flight (noise, vibration acceleration, and weightlessness; and (3) those which characterize the life of an organism under the artificial conditions of a spaceship (isolation, limitation of space and movement, features of feeding, etc.). P.V.E.

N63-21201 Aerospace Medical Div. Brooks AFB, Tex. School of Aerospace Medicine
MEASUREMENT OF HUMAN BODY FAT: A QUANTITATIVE METHOD SUITED FOR USE BY AVIATION MEDICAL OFFICERS
Thomas H. Allen June 1963 10 p 12 refs
(SAM-TDR-63-45)

Various volumes of the body are obtained by displacement of water in a specially constructed volumeter. From the total body-tissue volume and body weight, one calculates the quantity of body fat. A comparison of two subjects illustrates points of interest in physical examinations. Author

N63-21214 Joint Publications Research Service, Washington, D.C.
EXOBIOLOGY — A NEW FIELD OF SCIENTIFIC RESEARCH
A. A. Imshenyetskiy Mar. 11, 1963 13 p Transl. into ENGLISH from Vestnik Akad Nauk SSSR (Moscow), v. 32, no. 11, 1962 p 58–63
(JPRS-18004; OTS-63-21389) OTS: $0.50

A discussion is presented of problems associated with the performance of experiments in the area of exobiology, either at the present time or in the near future, especially those concerning possible modes of discovering life in space and the influence of cosmic conditions on living cells. P.V.E.

N63-21218 Aerospace Medical Div. Holloman AFB, N. Mex. Aeromedical Res. Lab. (6571st)
CHIMPANZEE PERFORMANCE ON A CONTINUOUS AVOIDANCE TASK DURING ACCELERATION AT SUSTAINED LOW LEVELS [Interim Report]
Donald N. Farrer, Marvin E. Grunzke, Gregg A. Gilbert, Gary T. Barnhart, and Paul D. Jacobs Mar. 1963 33 p 6 refs
(ARL-TDR-63-6)

Chimpanzee performance during 1 G, 2 G, and 4 G was evaluated with a pilot study (one subject) and a crossover design (four subjects). Each test lasted 90 minutes (30 minutes at 1 G; 30 minutes at either 2 G or 4 G; 30 minutes at 1 G). Performance, heart rate, respiration rate, and body temperature were monitored. It was concluded that a performance decrement results during exposure to 4 G (chest to back, $+G_x$) for 30 minutes. The heart rate was high throughout all tests, but it increased while the subject monitored the cue lights and decreased during rest periods. The respiration rate does not consistently change as a function of either G force or work. Body temperature consistently decreased during the tests. Author

N63-21263 Battelle Memorial Inst., Columbus, Ohio
A STUDY OF NEAR INFRARED EMISSION FROM THE MAMMALIAN CEREBRAL CORTEX [Final Report, Apr. 1962–Mar. 1963]
Richard M. Roppel et al Wright-Patterson AFB, Ohio, Biophysics Lab., June 1963 22 p 4 refs
(Contract AF 33(657)-8056)
(AMRL-TDR-63-66)

Experiments were conducted to investigate the existence and quantitative characteristics of photon radiation from the mammalian cerebral cortex, in excess of that due to thermal radiation. Surgical exposure of the cerebral cortex of several mammalian species was performed, and various forms of radiant energy transducers were employed to detect and/or to measure the intensity of radiation of cortical origin. In some experiments, observations were carried out during electrical and chemical stimulation of the cortex. Measurements of emitted radiation were also made during termination of the animals by injection of cytotoxic materials into the brain via the carotoid artery to achieve a rapid cessation of vital activity of the cortical tissue. Author

N63-21301 General Electric Co., Philadelphia, Pa.
THE PATHOPHYSIOLOGY OF DISUSE AND THE PROBLEM OF PROLONGED WEIGHTLESSNESS: A REVIEW
Richard W. Lawton and Michael Mc Cally Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs., June 1963 51 p 169 refs
(AMRL-TDR-63-3) OTS: $1.50

The purpose of this review is to proceed from the present state of knowledge of normal human physiological systems, particularly as their structure and function are affected by gravity, to a consideration of the possible physiological consequences of prolonged human exposure to zero-G. Methods used to produce and to simulate zero-G are briefly reviewed. The data suggesting that prolonged weightlessness will be a deconditioning environment are presented. These data are considered for possible untoward effects of prolonged exposure to weightlessness, and for methods of prevention of undesired effects. The problem of artificial gravity by rotation of a space vehicle is briefly considered. Author

N63-21305 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SPACE TRAVEL AND HUMAN THERMAL LIMITS: A SELECTED BIBLIOGRAPHY
Robert C. Gex, comp. Feb. 1962 169 p 424 refs Addendum to Space Mater. Handbook
(Contract AF 04(647)-673)
(SB-61-33; AD 296343) OTS: $12.00

This selected bibliography, partially annotated, is divided as follows: (1) physiological mechanisms of temperature regulation; (2) metabolism; (3) thermal properties of tissues; (4) comfort criteria; (5) thermal indices and units; (6) compensable zone (high temperature); (7) compensable zone (low temperature); (8) hyperthermic zone (noncompensable); (9) hypothermic zone (noncompensable); (10) heat- and/or cold-resistant clothing, including ventilated pressure suits; (11) combined thermal and other stresses (hypoxia, acceleration, etc.); (12) acclimatization; (13) hibernation; and (14) thermal models of humans. The 424 references are listed alphabetically by author under each category. Emphasis was placed on the literature since 1957. Author

N63-21322 Retina Foundation, Boston, Mass. Inst. of Biological and Medical Sciences
STUDIES OF CERTAIN BIOLOGICALLY IMPORTANT POLYANION-ORGANIC CATION COMPLEXES AS ENERGY TRANSFER SYSTEMS Final Report
Endre A. Balazs and D. S. Scheufele Apr. 30, 1963 75 p 37 refs
(Contract AF 19(604)-8476; ARPA Order 171-62)
(AFCRL-63-839)

Visible absorption spectra were made of glucosaminoglycan and galactosaminoglycan fractions and two molecular weight moieties of sodium polyethylene sulfonate complexed with Azure A dye. The parameters investigated were: method of preparation; polymer anionic site-to-dye ratio; temperature; solvent polarity; added electrolyte; pH; centrifugation; chloroform extraction; and time. Ultraviolet, fluorescent, and infrared spectra were also determined. Evidence for time-dependent spectral shifts and metachromasia without a substrate was obtained. Author

17 MACHINE ELEMENTS AND PROCESSES

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

N63-20722 Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
TESTING OF PUMPS FOR USE IN NITRIC ACID-ALUMINA SLURRY SERVICE
E. J. Bailey AEC Nat'l. Reactor Testing Station, May 1963 26 p 3 refs
(Contract AT(10-1)-205)
(IDO-14612) OTS: $0.50

Two different types of centrifugal pumps have been used successfully for pumping a nitric acid–alumina slurry, produced in the off-gas scrubbing system of the Waste Calcining Facility. Adequacy of a vertical, suspended-shaft, centrifugal, double-volute pump with nonwetted bearings and packing was demonstrated in plant-scale tests. A vertical, deep-well, turbine-type pump, with the submersed bearings made of boron carbide working against Type 440-C hardened stainless steel, also proved to be acceptable for this service in pilot-plant tests. Author

N63-20725 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS. REVIEW OF RECENT DEVELOPMENTS
W. A. Gibeaut and J. J. English July 26, 1963 2 p 8 refs

Recent developments in protective coatings for niobium, tantalum, molybdenum, and tungsten are reviewed. The coatings-evaluation data compiled for each of these refractory metals includes (1) the ability of coatings to provide oxidation protection, (2) the high-temperature mechanical properties of the coating systems, and (3) the influence of the coating and application process on substrate properties. M.P.G.

N63-20789 Army Missile Command, Huntsville, Ala. Redstone Arsenal
SURVEY OF RECOMMENDATIONS BY HUMAN FACTORS ENGINEERING EVALUATORS DURING ARMY MISSILE SYSTEMS DEVELOPMENT PROGRAMS
Gerald Chaikin, comp. Aug. 28, 1963 20 p
(RC-S-63-1)

This study classifies and tabulates 1311 human-factors engineering recommendations furnished by an independent evaluating activity during the design and development of seven Army missile systems. The tabulated data were obtained from assessments of entire systems, rather than system segments. Author

N63-20798 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
WEAR AND FRICTION OF MECHANICAL CARBONS IN LIQUID OXYGEN AS INFLUENCED BY TRANSFER FILMS
William F. Hady, Gordon P. Allen, and Robert L. Johnson Repr. from ASLE Trans. v. 6, 1963 p 201–208 10 refs
(NASA-RP-5)

Experimental wear and friction studies were conducted with a series of mechanical carbons sliding against metal surfaces in liquid oxygen (−298° F), at sliding velocities to 6500 fpm, and a load of 1000 gm. High-density graphitic carbons with a greater oxidation resistance and a greater capability of forming a transfer film gave the lowest wear and friction. Metals that form the most stable oxide films promote greater adherence of the graphite to the mating surface. Impregnated carbons must be selected with caution because frictional heating generated during sliding can initiate hazardous reactions between oxygen and certain unstable organic compounds. Author

N63-20800 Joint Publications Research Service, Washington, D.C.
RELATIONSHIP BETWEEN VEGETATION AND RELIEF
Pal Jakucs Aug. 30, 1963 20 p 9 refs Transl. into ENGLISH from Földrajzi Ertesitö (Budapest), v. 11, no. 2, 1962 p 203–215 Presented at the 10th Anniv. Conf. of the Geogr. Res. Group, Hung. Acad. of Sci.
(JPRS 20888; OTS: 63-31664) OTS: $0.50

The relationship between vegetation and relief can be two sided. On the one side, the plant covering is featured among the surface-shaping factors; on the other, the already formed geomorphological shapes, interacting with other environmental factors, determine and direct the laws of the appearance and composition of the vegetation found on them. These in turn react again on the relief, exemplifying the perpetual interaction within the dialectic unity of the animate and the inanimate. The development of the slopes of the surface is collectively caused and determined by the measure of degradation, and the peculiar properties of the surface-building rocks. The same external effects bring about different shapes due to differences in the material of the surface-building rocks. Thus, the morphological formations of limestone, dolomite, basalt, loess, etc., are different. Beyond the individual effect of the basic rock, these peculiar morphological formations play an essential role in the formation of their vegetation covering to a greater or lesser degree. P.V.E.

N63-20817 National Research Council, Washington, D.C. Committee on Pathologic Effects of Atomic Radiation
THE TREATMENT OF RADIATION INJURY Report of the Subcommittee on The Treatment of Acute Radiation Injury
Shields Warren 1963 26 p 13 refs
(NAS-NRC Publ. 1134) Available from NAS: $1.00

Treatments for cases of acute radiation syndrome are discussed. A high dose of uniform whole-body radiation may induce the following: (1) neurological–behavioral–psychological manifestations—headache, weakness, insomnia, depression, etc., (2) gastrointestinal disturbances—nausea, vomiting, diarrhea, and anorexia, (3) hematological changes—leukopenia, thrombocytopenia, and anemia, (4) cardiovascular-respiratory disturbances—tachycardia, arrhythmia, hypotension, and shortness of breath. In most cases of whole-body exposure it is

probable that the dose will be nonuniform and of unknown distribution. Treatment must therefore be governed by the type and extent of the injury. P.V.E.

N63-20892 National Aeronautics and Space Administration, Washington, D.C.
STUDY OF SENSORY DEPRIVATION, PAIN AND PERSONALITY RELATIONSHIPS FOR SPACE TRAVEL [Final Report, Nov. 1, 1961-Oct. 31, 1962]
J. Peters, F. B. Benjamin, W. M. Helvey and G. A. Albright (Republic Aviation Corp., Farmingdale, N.Y.) Sept. 1963 72 p 28 refs
(Contract NASr-74)
(NASA TN D-2113) OTS: $2.00

A study was conducted to determine the relationships between the ability to endure pain, performance on the personality scales of both the Minnesota Multiphasic Personality Inventory (MMPI) and the Edwards Personal Preference Schedule (EPPS), and the ability to endure reduced sensory-input conditions. The results of the study indicated that (1) there were no consistent or notable differences between the pain-endurance selected subjects on most of the personality scales of the MMPI and the EPPS; (2) the relationship between the ability to endure pain and the ability to endure reduced sensory-input conditions was not statistically significant. Author

N63-20904 Joint Publications Research Service, Washington, D.C.
TESTIS INJURY IN MATURE MICE AS A RESULT OF SINGLE AND FRACTIONAL IRRADIATION DURING THE PERIOD OF EMBRYONIC DEVELOPMENT
N. N. Kuznetsova Sept. 6, 1963 8 p 9 refs Transl. into ENGLISH from Zh. Obshch. Biol., v. 24, no. 3, 1963 p 221-225
(JPRS-20960; OTS-63-21697) OTS: $0.50

Testis injury in mature mice as a result of single and fractional irradiation during the period of embryonic development was investigated. No diminishment in testicular injuries with fractional doses was observed. Fractional delivery of 200 roentgen units demonstrated summated effects varying as to extent; fractional delivery of 100 and particularly of 400 roentgen units demonstrated a summation of injuries that were very similar in extent. Patterns of summation of testicular injuries with irradiation of mature animals and embryos are the same; in both instances fractional irradiation elicits summation of testicular injuries. With fractional irradiation of the testis during the critical period of embryonic development the injuries are summated, thus indicating that there is a danger from repeated penetrating radiation (roentgenoscopy and fluoroscopy) procedures for human embryos. P.V.E.

N63-20905 Joint Publications Research Service, Washington, D.C.
STUDIES OF PROTECTION OF MAMMALS AGAINST RADIATION
A. Ya. Grayevskiy, N. F. Barakina, M. M. Konstantinova, and I. B. Smirnova Sept. 6, 1963 20 p 27 refs Transl. into ENGLISH from Zh. Obshch. Biol., v. 24, No. 3, 1963 p 182-193
(JPRS-20964; OTS-63-31698) OTS: $0.50

An investigation of the radiation protective activity of certain protective agents which reduce the tissular oxygen tension (sodium nitrite and adrenalin) and some which do not affect it (amino-ethyl-iso-thiouronium [AET], cysteamine, and cystamine) at various oxygen tensions in the inhaled air, and the effect of protective substances on morphological changes in radiation-sensitive organs under the influence of radiation is discussed. Experiments were conducted on albino mice of both sexes, 8 to 12 weeks old, and weighing 18 to 20 grams. The animals received single doses of Co^{60} gamma rays in the amount of 700 roentgen units at a rate of 320 to 280 roentgen units per minute in normal atmosphere (21% oxygen) and in an atmosphere containing 98 to 99% oxygen. It is concluded that regardless of the mechanism of antiradiation action of the protective agent, its protective effect on the organism is ultimately expressed by more rapid restoration of tissular radiation injuries. This accelerated regeneration of tissues is governed by: (1) preservation of a larger amount of cellular elements, (2) reduction in the number of cells with chromosomal defects elicited by radiation, and (3) more rapid restoration of mitotic activity. P.V.E.

N63-20920 Stanford U., Palo Alto, Calif. School of Medicine
SPEECH DISCRIMINATION OF HEARING-IMPAIRED INDIVIDUALS IN NOISE – ITS RELATIONSHIP TO OTHER AUDIOMETRIC PARAMETERS
Mark Ross, Dorothy A. Huntington, Hayes A. Newby, and Richard F. Dixon Brooks AFB, Tex., School of Aerospace Med., Apr. 1963 29 p 28 refs
(Contract AF 41(657)-376)
(SAM-TDR-62-130)

This study evaluated the relationships of speech discrimination measures obtained in quiet and in noise with various distortion indexes, with a group of subjects having sensorineural hearing loss: The results indicated that the most important factors associated with speech intelligibility were the extent and configuration of the hearing loss. The interrelationships among difference limen (DL) tests for frequency and intensity, linear range measures, age, and pure-tone thresholds were examined. Comparisons were made with normal-hearing listeners. Author

N63-20956 General Dynamics/Fort Worth, Tex.
EVALUATION OF MATERIALS FOR USE IN ELECTRONIC SYSTEMS OF HYPERSONIC SPEED VEHICLES
A. C. Porter Aug. 5, 1963 29 p 11 refs
(Contract AF 33(657)-11214)
(ERR-FW-069)

A literature survey and test data were used to evaluate materials for use in electronic systems of hypersonic vehicles. Wire and printed circuit coatings, electric potting compounds, and flexible cushion inserts were evaluated. Five combinations of ceramic-insulated wires and coatings were exposed to 700° F for 10 hours. Only Teflon resin sealed ceramic-insulated wire exhibited satisfactory dielectric strengths after aging and after humidity exposure. Four elastomeric and one ceramic potting compound were molded into test specimens, then aged for 10 hours at 700° F. The elastomeric compounds exhibited severe deterioration; only one compound retained its elastomeric properties. The ceramic compound was essentially unaffected by temperature but showed hydroscopic tendencies. Twenty-five elastomeric flexible cushion inserts were aged for varying periods of time at 700° F. None of the compounds were suitable for test after 10 hours, but six had measurable properties after aging 7 hours. P.V.E.

N63-20973 Aerospace Medical Div. Brooks AFB, Tex. School of Aerospace Medicine
RAPID, ACCURATE ANALYSIS OF BLOOD LACTATE
James P. Ellis, Jr., Stephen M. Cain, and Edgar W. Williams June 1963 12 p 4 refs
(SAM-TDR-63-49)

A method is described for the enzymatic analysis of blood L-lactic acid. The method incorporates certain unique features

which permit a rapid and precise analysis of a large number of samples. One of the more important features is the use of a simplified procedure for correcting the problematic drift of the unstable reaction mixture. In addition, conditions for the enzymatic activity were established which facilitate complete oxidation of lactate in 30 to 35 minutes. A comparative analysis of several blood filtrates, using the present method versus a well-known chemical method, as well as recovery analyses using the two methods, establishes the validity of the present test system. Author

N63-21025 Joint Publications Research Service, Washington, D.C.

THE PROBLEM OF TRANSPLANTATION OF HEMOPOIETIC TISSUE IN THE TREATMENT OF RADIATION INJURY

P. D. Gorizontov, M. F. Sbitneva, and M. N. Trushina Sept. 6, 1963 12 p 27 refs Transl. into ENGLISH of an article from Patol. Fiziol. i Eksperim. Terapiya (Moscow), no. 3, 1963 p 15–20

(JPRS-20948; OTS: 63-31688) OTS: $0.50

Experiments were conducted on animals to determine the survival effect of hemopoietic tissue transplantation for the treatment of radiation injuries. The transplantation of homologous embryonic liver cells or of bone marrow cells in rats irradiated with a dose of 750 rad (LD_{100}) was found to have practically no influence on the survival of the animals. The combination of this therapy with biomycin treatment saved 50 to 75 percent of the animals from death by the 30th day. By the 120th day, because of homologous production of cross reacting antibodies, the number of surviving rats was reduced to approximately one half. For the treatment of acute radiation sickness in rats, transfusion of a suspension of embryonic liver cells was more effective than the transplantation of bone marrow cells. The effectiveness of the therapy depended on the number of cells and the times of their injection. The best results were obtained from transfusion given in the first few hours or first day after irradiation with a maximum number of cells in the suspension. The transplantation of homologous bone marrow to dogs irradiated with a dose of 300 rad (LD_{95}) somewhat increased the effectiveness of comprehensive therapy. The mechanism of the therapeutic effect of hemopoietic tissue transplantation cannot be reduced simply to the effect of its acceptance. There is reason to believe that transplantation acts on the metabolic tissue processes, particularly on the recipient's DNA. C.L.W.

N63-21036 Joint Publications Research Service, Washington, D.C.

SOVIET STUDIES OF SPACE EMBRYOLOGY

A. Neyfakh Apr. 8, 1963 8 p Transl. into ENGLISH of an article from Nauka i Zhizn', Moscow, no. 1, Jan. 1963 p 65–67 (JPRS-18589; OTS: 63-21528) OTS: $0.50

The development of an organism during spaceflight was investigated. Effects of a closed biological cycle on an embryonic organism, the effects of high energies as are seen in primary cosmic radiation, and the effects of weightlessness on the symmetrical development of an embryo, are discussed. Studies were undertaken to determine the role that the forces of gravity play in the early development of embryonic organisms and to determine the effects of overloading and vibration in spaceflight. Preliminary model experiments were conducted which examined individually the effects of overloading and vibration on the development of various embryos in the early stages. It was shown that those accelerations and vibrations which accompany liftoff and reentry do not exert markedly damaging effects. Chilled undeveloped eggs of the parasitic worm, nematode, were placed on spaceships, and, under conditions of spaceflight at normal temperature, they passed through definite stages of development. Following reentry they were chilled again and in this form transferred to the laboratory. There it was observed how their development following the flight transpired, and it was found that no marked deviations resulted from the conditions of spaceflight. C.L.W.

N63-21062 Franklin Inst., Philadelphia, Pa.

BIO-INSTRUMENTATION FOR THE STUDY OF BIOLOGICAL RHYTHMS

Repr. from Franklin Inst. Lab. Rept., July 1963 p 1–2

(NASA Contract NASr-146)

Research on the cyclic variations within a living organism or between an organism and its environment is discussed. Efforts were focused on the design of an actograph, so constructed that data on the activity of its inmate can be generated continuously, and on the simultaneous development of a temperature-sensitive transmitter for implanation in small animals. The actograph consists of a series of electronic detectors sufficiently sensitive to sense each time the occupant eats, drinks, or moves about. A cockroach was chosen as the occupant of the actograph because it requires very little food, water, or attention and can withstand terrific stresses. The data obtained from rhythm experiments, both on earth and in satellites, will be useful in determining whether astronauts will require special environments when they are in space for extended periods of time. C.L.W.

N63-21113 SKF Industries, Inc., Philadelphia, Pa.

INFLUENCE OF LUBRICATION ON ENDURANCE OF ROLLING CONTACTS First Summary Report, June 22, 1961–Mar. 22, 1963

T. Tallian, L. B. Sibley, Y. P. Chiu, J. Martin, D. F. Hutteloche r et al [1963] 73 p 20 refs

(Contract NOw-61-0716-C)

(AL63T011)

A comprehensive research program to determine the effect of lubrication on the fatigue life of rolling contacts is in progress. In a rolling four-ball configuration, radioactive tracer techniques have been used to determine the existence of elastohydrodynamic lubricant films (by the absence of wear at the contact between two 1/2 balls in rolling and spinning contact at various values of load, speed, and lubricant viscosity. Electrical conductivity measurements across such a contact indicate the existence of microcontact occurrences as the hydrodynamic film becomes thinner. Good correlation was found between such conductivity measurements and a probabilistic treatment of the surface microgeometry parameters measured on the test balls. Elastohydrodynamic formulas for film thickness were reasonably verified. X-ray techniques for the measurement of the film thickness, and the deflected contour profile of the contact region between two rolling balls, have been refined and incorporated into the design of a special two-ball machine now under development. Author

N63-21120 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

JPL-25-FOOT SPACE SIMULATOR SOLAR PERFORMANCE AND MARINER TEST RESULTS COMPARED TO FLIGHT DATA

W. R. Howard Apr. 24, 1963 24 p Presented at the NASA Conf. on Solar Simulation Res. and Tech., Washington, Feb. 27–28, 1963

(NASA Contract NAS7-100)

(NASA CR-50997; JPL-TM-33-137) OTS: $2.60 ph, $0.50 mf

Jet Propulsion Laboratory 25-foot space simulator was modified to concentrate all the available radiant energy in a light beam (5-foot solar simulator system) of sufficient size and intensity to test the Ranger and Mariner spacecraft. A Mariner 3 spacecraft was thermally tested in the simulator and data was yielded which agreed acceptably with flight data obtained from Mariner 2 enroute to Venus. Because of performance, the Jet Propulsion Laboratory 25-foot space simulator equipped with a 5-foot solar simulation system is considered to be the best experimental tool available to proof test the Ranger and Mariner spacecraft. C.L.W.

N63-21300 General Motors Corp., Bristol, Conn.
RESEARCH AND DEVELOPMENT OF AIRFRAME BEARINGS FOR AEROSPACE VEHICLES [Final Report, May 1962-June 1963]
R. J. Matt, J. B. Muratore, R. E. Murteza, and C. J. Zupkus Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Sept. 1963 107 p 12 refs
(Contract AF 33(657)-8431)
(ASD-TDR-63-716)

The purpose of the program was to acquire the materials performance characteristics necessary to design control-surface bearings for future space reentry vehicles. The friction, wear, and limiting load capacity of candidate superalloy, cermet, and ceramic specimen materials, with and without lubricants, were studied at temperatures of from −100° F to 2500° F in air. Subsequent tests were run at temperatures of from −100° F to 1500° F in an ultrahigh vacuum ranging from 10^{-6} to 10^{-9} torr. Results indicated significant differences in performance of the selected materials. None of the tested lubricants provided any significant improvement. The effect of ultrahigh vacuum substantially increased the coefficient of sliding friction and did not appear to increase the coefficient of rolling friction. High-temperature reentry-vehicle control-surface bearing materials appear feasible. Additional work is required to demonstrate the effects of thermal and mechanical shock, and variable duty cycle. Author

18 MATERIALS, METALLIC

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Non-metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-20695 France. Ministere de l'Air, Paris
STRUCTURAL STUDY OF ZT1 ALLOY. PHENOMENA OF HYDROGENATION AND OXIDATION [ETUDE STRUCTURALE DE L'ALLIAGE ZT1. PHENOMENES D'HYDRURATION ET D'OXIDATION]
Guy Bronoel Paris, Service de Documentation et d'Information Technique de l'Aeronautique, 1963 92 p 65 refs In FRENCH (Its Publ. Scientifiques et Techniques No. 129) Available from SDIT, 2, Ave. de la Porte d'Issy, Paris (15e)

In the light of the interest shown in ultralight alloys for aeronautical purposes, the determination of the nature of the phenomena limiting the use of one of these alloys, ZT1, (magnesium-thorium-zinc-zirconium) at elevated temperatures was undertaken. The structural evolution of the alloy as a function of temperature and its reaction to oxidation are described. Also, the influence of internal hydrogenation (thermochemical treatments seldom used but of great interest) on ZT1 have been studied. Trans. by I.v.L.

N63-20697 Wien U., Austria
INVESTIGATION OF THE EFFECTS OF ULTRASONICS ON THE DEFORMATION CHARACTERISTICS OF METALS Interim Report No. 2, May 1-July 31, 1963
1963 12 p 4 refs
(Contract N 62558-3436)
(Rept.819)

The report presents results illustrating the importance of ultrasonic influence on the behavior of zinc crystals in static tensile tests. Hardening by irradiation with ultrasonics of high energy is being examined under varying experimental conditions. Increase in intensity and duration of irradiation increases hardening. With the preirradiation strain, the hardening effect decreases. The investigation of thermal recovery of shear hardening caused by ultrasonic influence shows that the temporal reduction of the critical shearing stress of the basal plane occurs much faster than in the case of hardening through cold-working. The recrystallization of polycrystalline zinc specimens by irradiation revealed a temperature difference between the irradiated specimen and the temperature of the bath used. Therefore, special care had to be taken in comparing irradiated specimens with nonirradiated ones. Author

N63-20701 College of Aeronautics, Cranfield (Gt. Brit.)
THE DEVELOPMENT AND EVALUATION OF AN ULTRASONIC FATIGUE UNIT
T. E. Clifton, B. S. Hockenhull, and A. R. Sollars Mar. 1963 17 p 10 refs
(CoA-141)

A fatigue-test apparatus operating at 20 kc/sec is described. The unit is based on a standard magnetostrictive drive system as used in high-energy stress-wave generators. An automatic counting device has been developed and incorporated in the final equipment, resulting in improvements in accuracy and reproducibility of results. Some typical results of tests on aluminum alloys are presented. Author

N63-20765 Iowa State U. of Science and Tech., Ames
THE WORK HARDENING OF AMES THORIUM
D. E. Williams and W. L. Larsen Apr. 1, 1963 17 p 4 refs
(Contract W-7405-eng-82)
(IS-576) OTS: $0.50

The work-hardening characteristics of Ames thorium are described in terms of Bickers and Rockwell-E hardness measurements made on cold-rolled and cold-swaged specimens. The Vickers work-hardening curves obtained from both types of deformation were found to increase rapidly up to approximately 10% reduction, then remain relatively flat throughout a large intermediate range. Above about 60% reduction, the hardness was again observed to rise more rapidly. The Rockwell-E work-hardening curves of specimens deformed by cold rolling were similar to the Vickers curves in the early and intermediate stages. However, the final portions of the Rockwell-E curves were flatter than those produced by Vickers measurements. The Rockwell-E work-hardening data from cold-swaged specimens were in closer agreement with those for cold-rolled specimens, after the data from the swaging experiments were corrected for error introduced by the cylindrical shape of the specimens. Author

N63-20876 Institute of Environmental Sciences, Washington, D.C.
THE DYNAMIC ENVIRONMENT Lecture Notes
1962 483 p 177 refs Jointly sponsored lecture series presented at George Washington U., Sept. 25–Dec. 18, 1962 (*Its* Environ. Tech. Lecture Series)

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Lecture 12. ENVIRONMENTAL TESTING W. R. Forlifer (NASA, Goddard Space Flight Center) 27 p 12 refs (See N63-20887 21-33)

N63-20957 General Dynamics/Fort Worth, Tex.
ENGINEERING RESEARCH – BRAZING ALLOY – "DYNABRAZE B" – COMPOSITION OPTIMIZATION OF
W. M. Pratt Dec. 6, 1962 18 p
(Contract AF 33(657)-11214)
(ERR-FW-178)

The object of this test was to establish the optimum manganese content in Dynabraze B brazing alloy (95% silver, 5% aluminum + manganese) to develop the best combination of crevice corrosion resistance, lap shear strength and brazability. The range of manganese content from 0.5% to 1.0% appears to be the best of the groups studied, judging from the results of the corrosion tests and metallographic studies. However, the shear-strength values, when coupled with the results of the metallographic studies indicate superiority in the manganese content of 1.0%. Author

N63-20959 Oklahoma U., Norman
GRAIN BOUNDARY DIFFUSION IN LEAD Final Report
J. P. Stark and W. R. Upthegrove May 31, 1963 102 p 47 refs
(Contract Nonr 982-(04))

The purpose of this research was to investigate grain-boundary self-diffusion in high purity lead and, specifically, to study the influence of orientation and impurity content upon this phenomena. Bicrystals of zone-refined lead were grown from the melt with various tilt and twist grain-boundary orientations to study the effect of misfit. For the study of impurity effects, bicrystals with similar misfit were grown with lead containing varying amounts of the impurities tin, thallium, indium, and bismuth. Diffusion experiments were carried out using high-resolution autoradiography and lead-210. Diffusion coefficients were determined from the Whipple and Fisher diffusion models with the data of depth of penetration measurements. The impurity study resulted in the observation of a 50-percent decrease in the grain-boundary self-diffusion coefficient of lead in a 30-degree tilt grain boundary with increasing concentrations of tin, thallium, and indium. The activation energy for grain-boundary diffusion decreased slightly with increasing impurity contents. Author

N63-20971 Climax Molybdenum Co. of Michigan, Detroit
STUDIES OF REFRACTORY ALLOY SHEET MATERIALS Quarterly Report, Mar. 15–June 15, 1963
Robert Q. Barr, Paul R. Pfefferle, and M. Semchyshen [1963] 12 p
(Contract NOw-62-0419-c)

The following alloys have been consolidated by the vacuum-arc casting process: (1) Mo + 1.59% Cb + 0.52% Ti + 0.21% Zr + 0.068% C; (2) Mo + 1.30% Ti + 0.35% Zr + 0.093% C; (3) W + 3.10% Mo + 0.04% Zr + 0.001% C. Machined blanks from the ingots have been extruded to rectangular bar form in preparation for rolling to sheet. The extruded bars have been evaluated in terms of recrystallization behavior, and response to solution and aging treatments. Author

N63-21010 General Dynamics/Fort Worth, Tex.
PROCESS EMBRITTLEMENT RELIEF TREATMENT FOR FLASH-ELECTROLYTIC-ELECTROLESS NICKEL PLATED 4340 (200-220 & 260-292 KSI) AND AN H-11 TOOL STEEL (250-280 KSI), EVALUATION OF
S. V. Glorioso Aug. 5, 1963 7 p
(Contract AF 33(657)-11214)
(FTDM-3013)

Samples of electroless nickel plated SAE 4340 steel and Vascojet 1000 tool steel were subjected to variations of after-plate bake time and temperature to determine if this will eliminate hydrogen embrittlement in the plating. The SAE 4340 steel specimens were austenitized 30 minutes at 1575° F and quenched in agitated oil and subsequently double tempered 2 hours at 400° F or 800° F depending on the desired strength level. The Vascojet 1000 steel was austenitized 30 minutes at 1850° F, air cooled and subsequently double tempered at 1050° F for 2 hours each time. The plated steels tested showed no evidence of hydrogen embrittlement after each of the bake time and temperature combinations investigated. The following baking cycles are recommended: SAE 4340 at 200 to 220 ksi, 8 hrs at 375° F; SAE 4340 at 260 to 280 ksi, 23 hrs at 375° F; and Vascojet 1000 at 250 to 280 ksi, 1 hr at 600° F. P.V.E.

N63-21011 General Dynamics/Fort Worth, Tex.
PROCESS CONTROL – EFFECT OF ACID CLEANING OF THE MECHANICAL PROPERTIES OF 17-4 PH STEEL IN VARIOUS HEAT TREATED CONDITIONS Process Control Test Report, July 25, 1960–Nov. 29, 1960
W. A. Token Aug. 5, 1963 18 p
(Contract AF 33(657)-11214)
(PCTR-4577)

Cleaning 17-4 steel parts as specified will not produce embrittlement in 17-4 PH wrought forms at nominal strength levels. Because of the difficulty in controlling aggregate immersion time, 17-4 PH steel parts, castings, and wrought, should not be acid pickled. Acid pickling will not embrittle 17-4 PH steel parts, but susceptibility to failure due to intergranular attack will increase proportionally to increase in immersion time. Author

N63-21015 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

REVIEW OF RECENT DEVELOPMENTS: TUNGSTEN AND TUNGSTEN-BASE ALLOYS

V. D. Barth Aug. 23, 1963 4 p 29 refs

Results of metallurgical investigations of tungsten and its alloys include: (1) Tungsten tubing for nuclear use has been produced by the extrusion of sleeves around molybdenum cores. (2) Tungsten sheets 36 by 36 inches and 0.060, 0.040, and 0.020 inch thick have been rolled. (3) Oxygen additions to single-crystal tungsten produced only a slight increase in the ductile–brittle transition temperature (from about 0° to 80° F for an increase from 2 to 20 ppm). (4) The following new free energy of formation values were calculated:

$$\Delta G_{W_2C}^{1800C} = -5000 \pm 1400 \text{ cal/mol;}$$

and

$$\Delta G_{WC}^{1800C} = -3600 \pm 1200 \text{ cal/mol.}$$

(5) A new phase WB_{12} was found. (6) The temperature dependence of the diffusion coefficients of tungsten into tungsten, and rhenium into tungsten, can be represented by the equations:

$$D_{W-W} = (42.8 \pm 4.8)e^{-(153,100 \pm 600)/RT} \text{ cm}^2/\text{sec}$$

and

$$D_{Re-W} = (275 \pm 110)e^{-(162,800 \pm 2,500)/RT} \text{ cm}^2/\text{sec.};$$

(7) The sublimation of tungsten can be suppressed significantly at a given temperature by an increase in hydrogen pressure. (8) Good correlation between flaws detected by pretest inspection and cracking in shock has been observed in preliminary thermal-shock tests on silver-infiltrated tungsten nozzles. (9) The prediction of the self-cooling behavior of zinc-, silver-, and magnesium-cooled tungsten has been made possible by using a theoretical analysis. It is indicated that little change in the convective heat-transfer coefficients could be effected by these coolants, and that temperature distribution within the infiltrated structure was essentially dependent on the boiling point and rate of vaporization of the coolant. I.v.L.

N63-21042 Argonne National Lab., Ill.

TABULATIONS OF CALCULATED CRYSTALLOGRAPHIC DATA FOR ALPHA PLUTONIUM

Alan F. Berndt and Lowell T. Lloyd June 1963 95 p 8 refs

(Contract W-31-109-eng-38)

(ANL-6676)

Calculations have been made of the powder pattern, and of the angles between planes and directions for alpha plutonium, in order to provide useful data for interpretation of X-ray patterns. The calculated powder patterns for Cu, Ni, Co, Fe, Cr, and Ti Kα radiations are tabulated. The angles between planes and the angles between directions are listed, and the standard projections are presented. Author

N63-21175 Hanford Atomic Products Operation, Richland, Wash.

RADIATION EFFECTS ON ALUMINUM FILMING AND CORROSION

R. B. Richman Feb. 20, 1963 18 p 34 refs

(Contract AT(45-1)-1350)

(HW-76642) OTS: $0.50

Film deposition and corrosion were measured for aluminum samples exposed to a wide range of intensities of nuclear reactor radiation in pH 7.0, treated, Columbia River water preheated with steam to 90° C. Both the amount of film deposited and the extent of aluminum corrosion increased with radiation intensity. Author

N63-21180 National Lead Co. of Ohio, Cincinnati

SUMMARY TECHNICAL REPORT FOR THE PERIOD APRIL 1, 1963 TO JUNE 30, 1963

R. Burgett, ed. July 18, 1963 34 p 13 refs

(Contract AT(30-1)-1156)

(NLCO-885) OTS: $1.25

A summary of work is reported in the following areas: (1) *Use of lithium alloy to shorten bomb reduction firing time*—Plant-scale bomb reductions using hydrofluorinated green salt (UF_4) and magnesium were initiated by a suitably located lithium pellet; firing times were reduced from 250 min. to 135 min. (2) *High-temperature decomposition of uranium mononitride*—A high-temperature vaporization study of uranium mononitride has been completed; the enthalpy of decomposition of this compound has been determined to be 68.7 kcal/mole. (3) *Gamma-phase annealing of uranium containing phosphorous*—Uranium metal containing 400 ppm phosphorus was annealed for 6 hours at 1700° F in the vacuum heating stage metallograph; the uranium phosphide inclusions were found to be completely stable at the test temperatures. (4) *Recrystallization of uranium containing small additions of iron and silicon*—Samples of partially recrystallized alpha-rolled uranium containing dilute alloys of iron and silicon were studied; sample structures were observed at temperatures in the high alpha range and in the beta phase to study the recrystallization and phase transformations. (5) *Recovery of uranium by the precipitation of uranyl ammonium sulfite*—Uranyl ammonium sulfite has been precipitated from Scrap Recovery Plant leach liquor by pH adjustment with ammonium hydroxide and the addition of a concentrated solution of ammonium sulfite; relatively pure uranyl ammonium sulfite product can be calcined to U_3O_8 and used as a uranium source for UF_4 prepared by the Winlo process. P.V.E.

N63-21181 United Aircraft Corp., East Hartford, Conn. Research Laboratories

ANALYTICAL AND EXPERIMENTAL INVESTIGATIONS OF THE FRACTURE MECHANISMS OF CONTROLLED POLYPHASE ALLOYS Quarterly Progress Report No. 3, April 30, 1963 through July 29, 1963

J. A. Ford and R. W. Hertzberg Aug. 31, 1963 22 p

(Contract N600(19)59361)

(B-910068-3)

The results of continued investigations of the unidirectionally solidified eutectic alloys Cu–Cr, Al–$CuAl_2$, and Al–Al_3Ni are presented. Microbend tests were made on Al–$CuAl_2$ eutectic specimens for the 30-, 45-, and 60-deg plate orientations to complete the plate orientation–stress axis study. The results indicate a nonlinear decrease in strength from a maximum of 49,800 psi for the parallel case (zero degrees orientation), to a minimum of 16,700 psi for the normal case (90-deg orientation). The composite elastic modulus has been determined graphically. The fractographic analysis of unidirectionally solidified Cu–Cr tensile specimens whose tensile axes were oriented at an angle of 45 deg to the growth direction has been completed. Results indicate that: (a) the fractured surface was approximately parallel to the Cr whisker length and at 45 deg to the tensile axis; (b) the direction of shear failure was parallel to the line of the fibers. Tensile tests of Al–Al_3Ni eutectic specimens have indicated that the shoulder failures experienced in nearly all cases can be associated with a stress concentration effect. No significant increase in tensile strength in this alloy system was obtained as the size of the Al_3Ni whiskers decreases from about 2μ to 0.5μ. Graphically determined composite modulus data were obtained for the alloy. Author

N63-21189 Massachusetts Inst. of Tech., Cambridge
INVESTIGATION OF TOUGHNESS OF ALUMINUM MAGNESIUM WELDMENTS
C. M. Adams, Jr. Frankford Arsenal, Philadelphia, Pa., May 1963 43 p 5 refs
(Contract DA-19-020-507-ORD-4602)

The strength and plasticity of welded aluminum–magnesium alloys were investigated to determine the influence of such welding variables as arc energy input and filler metal composition on the overall strength and energy absorbing capabilities of alloy plate welded at different levels of initial cold work. The studies were conducted at low rates of strain, and the principal results were: (1) the variables of welding and initial plate condition generally exhibited a marked influence on the strain distributions observed in welds subjected to transverse tension, but the overall strength and toughness properties were surprisingly insensitive to process variables; (2) the plastic properties of the material in the weld zone, the heat-affected zone, and the unaffected base material frequently appeared in sharp contrast to one another as indicated by the nonuniformity of the strain distributions; (3) joint geometries and welding procedures were developed which reliably deposit welds substantially free of porosity; gas porosity, however, was found to exert little influence on the transverse tensile properties of the aluminum–magnesium alloys studied. M.P.G.

N63-21194 McDonnell Aircraft Corp., St. Louis, Mo.
ROLL SEAM WELDED TITANIUM
H. A. Koelling Sept. 10, 1963 7 p
(Contract AF 33(657)-11215 and BPSN: 63-6899-7381-738103)
(AO62)

Tests are conducted to determine the lap shear strength of roll seam welded titanium joints. Ten 1- X 8-in. strips were cut from each weldment and tested for lap shear strength. The results of the lap shear tests are presented in tabular form. J.R.C.

N63-21198 McDonnell Aircraft Corp., St. Louis, Mo.
REAGING OF INCONEL X SHEET MATERIAL AFTER SEAM WELDING
John Huebner Sept. 10, 963 21 p
(Contract AF 33(657)-11215)
(Rept. AO65)

Solar Aircraft has reported excessive distortion in the fabrication of BLC ducts when Inconel X sheet is seamwelded in the annealed condition and then heat treated. To eliminate this, Solar proposes to weld the Inconel X after heat treatment followed by reaging. To examine the effect of this procedure on the mechanical properties of Inconel X, three test panels were fabricated. Panel 1 was welded in the annealed condition and then heat treated (MAC procedure). Panel 2 was heat treated followed by welding, and Panel 3 was heat treated, then welded followed by reaging per Solar procedure. Tensile tests on specimens from these panels (welded and unwelded) showed equivalent mechanical properties for MAC and Solar Procedure. The hardness through the weld is slightly lower for the Solar procedure, but the hardness through the fusion zone and unaffected zone follows the same pattern as for MAC procedure. Welds in all panels showed some intrusion, and Panel 1 also showed excessive expulsion. Author

N63-21231 Texas Instruments, Inc., Dallas
VACANCY RELATED DEFECTS IN ANTIMONY DOPED SILICON
J. K. Howard (Ga. Inst. of Tech.) and D. P. Miller [1962] 26 p 21 refs

Antimony-doped silicon, grown by the "orbital process," is examined with X-ray topography, and the observed defects are correlated to the crystal growth. Crystal growth in different thermal environments is seen to influence the external shape of the crystal. The circular phase represents growth in a high thermal gradient and radial stress. The initial part of the circular phase is usually free from dislocations, but the latter part shows evidence of increasing curvilinear slip. If the crystal is doped in the 10^{18}Sb/cm^3 range and is withdrawn from the melt while growing, then other defects, such as helical dislocations, precipitation on loops, and random precipitation are observed. The transition region exhibits a reduction of heat flow during growth. The triangular phase is characterized by a planar solid–liquid interface, indicating low thermal gradients. The dislocation density in this phase is high and is attributed to thermal shock. P.V.E.

N63-21233 Midwest Research Inst., Kansas City Mo.
A STUDY OF THE PHYSICAL BASIS OF THE MECHANICAL PROPERTIES OF CERAMICS [Summary Report, 18 Apr. 1962–17 Apr. 1963]
Gordon E. Gross Wright-Patterson AFB, Ohio, AF Materials Lab., Aug. 1963 35 p 131 refs
(Contract AF 33(657)-8572)
(ASD-TDR-63-605, Pt. I)

A literature survey of the properties of ceramics, both classical and more recent solid-state theory, is presented. A better understanding of ceramic properties as related to their electron-lattice structure was gained by correlating the mechanical properties of brittleness and ductility with the electronic and crystalline (lattice) properties of materials. Experimental methods and results are given for surface energy and Hall coefficients measurements. Author

N63-21259 General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.
SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM Fourth Quarterly Progress Report, January–March 1963
H. H. Klepfer, E. L. Dunn, R. E. Blood, D. L. Douglass and J. S. Armijo AEC Div. of Tech. Inform., Apr. 1, 1963 61 p 10 refs
(Contract AT(04-3)189)
(GEAP-4211) OTS: $1.25

A program is in progress for the design of a zirconium base alloy for steam service as nuclear fuel cladding. Corrosion testing in high-pressure flowing steam at 300° C, 400° C and 500° C has now reached an exposure of 2500 hours. Mathematical expressions summarizing the mechanical properties of all alloys for the as-fabricated condition are reported. The tensile properties of 31 alloys tested at 300°, 400°, and 500° C are also reported. Postcorrosion mechanical-property measurements and postcorrosion hydrogen analyses are continuing. Fundamental studies are also in progress in support of the alloy design work. Activation analyses on stripped corrosion films have given more data on alloy element partitioning. A topical report has been issued summarizing measurements of hydrogen overvoltage and electrochemical potential for zirconium intermetallic compounds. Author

N63-21276 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
KINETICS OF THE OXIDATION OF PLATINUM
George C. Fryburg and Helen M. Petrus Repr. from J. Electrochem. Soc., v. 108, no. 6, June 1961 p 496–503 23 refs

The oxidation of platinum has been investigated employing electrically heated ribbons at temperatures from 900° to 1500° C and at pressures from 15μ to 1 at. An energy of

activitation of 42.5 kcal mole^{-1} has been obtained from the temperature dependence of the rate. An unusual pressure dependence has been observed which was found to result from the back-reflection of the volatile PtO_2 by the surrounding gas molecules. At 1 at. pressure, only a fraction of a percent of the PtO_2 formed escapes from the platinum.
Author

N63-21302 Lessells and Associates, Inc., Waltham, Mass.
ACOUSTIC EMISSION UNDER APPLIED STRESS [Interim Report, Apr. 15, 1962-Mar. 15, 1963]
B. H. Schofield Wright-Patterson AFB, Ohio, AF Materials Lab. Apr. 1963 23 p 24 refs
(Contract AF 33(657)-8562)
(ASD-TDR-63-509, Pt. 1)

This report concerns specific investigations undertaken to assess the role of the surface oxide layer in the generation of acoustic pulses in metals, i.e., acoustic emission. Experiments were conducted on single crystals of aluminum of different crystallographic orientation. The specimens were pulled in tension in atmosphere and exposed to etchant solutions. Results demonstrated the oxide layer is not itself an emission source, and that the emission characteristics are significantly modified as a result of the influence of the oxide on the deformation behavior of the specimens. Specific observations suggest the operative mechanism of emission generation, and the importance of the role played by the surface condition in the deformation of metals.
Author

N63-21308 General Dynamics/Fort Worth, Tex.
MATERIAL EVALUATION CHARPY IMPACT STRENGTH F-111 STEEL ALLOYS
F. I. Nordquist Aug. 5, 1963 11 p
(Contract AF 33(657)-11214)
(FTDM-3130)

The charpy impact strength of D6ac, H-11, and 4330-V alloy steels were determined at room temperature and at −65° F. The average room temperature impact strength exceeded 15 ft-lb when the tempering temperature exceeded 1000° F. Neither the H-11 or 4330-V alloy had 15 ft-lb strength when heat treated in excess of 220,000 psi. All the D6ac tests at −65° F exceeded 10 ft-lb as did the H-11 steel heat treated to 211,000 psi. All the other −65° F test result averages were less than 10 ft-lb. Of the three alloys tested, only D6ac had an average impact strength of greater than 15 ft-lb at room temperature when heat treated to the 220,000 to 240,000 psi range.
P.V.E.

N63-21329 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
A NEW SERIES OF ADVANCED-TEMPERATURE NICKEL-BASE ALLOYS
John C. Freche, William J. Waters, and Thomas J. Riley Repr. from High Temp. Mat. p 215–228 6 refs
(NASA RP-26)

Nickel-base alloys that do not require vacuum melting techniques and that provide high-strength properties at elevated temperatures, as well as a degree of workability, were developed. Both increased strength and workability were obtained by utilizing tantalum-alloying additions. The strongest alloy obtained in this investigation had a nominal composition of 8 wt-% tantalum, 6 wt-% chromium, 6 wt-% aluminum, 4 wt-% tungsten, 4 wt-% molybdenum, 2.5 wt-% vanadium, 1 wt-% zirconium, 0.125 wt-% carbon, and the balance, nickel. This alloy demonstrated average as-cast rupture lives of 1,200,560 and 185 hr at 15,000 psi stress, and temperatures of 1800°, 1850°, and 1900° F, respectively. Ultimate tensile strengths of 80,000, 54,300, and 49,200 psi were obtained at 1800°, 1900°, and 2000° F.
Author

19 MATERIALS, NONMETALLIC

Includes: mechanical and physical properties of non-metals (e.g., plastics).

***For related information see:* 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.**

N63-20766 Massachusetts Inst. of Tech., Cambridge, Mass.
STUDIES ON ELECTROMAGNETIC MEANS OF ADDING HEAT AND KINETIC ENERGY TO A GAS [Interim Technical Report, 1961-1962]
Eugene E. Covert, Charles W. Haldeman, James B. Coffin, Jr., and Laurence R. Boedeker Wright-Patterson AFB, Ohio, Aeronautical Res. Labs., May 1963 76 p 22 refs
(Contract AF 33(657)-7975)
(ARL-63-84)

Included are summaries of one-dimensional studies of plasma acceleration by traveling electromagnetic waves, studies of a consistent instrumentation procedure, and studies to determine the feasibility and design of an alternating current gas-ionizing device that will, by use of nonequilibrium processes, give a high electrical conductivity at relatively low temperatures.
Author

N63-20783 Stanford Research Inst., Menlo Park, Calif.
DYNAMIC PROPERTIES OF ROCKS Final Report
V. G. Gregson, T. J. Ahrens, and C. F. Petersen Aug. 15, 1963 88 p 25 refs
(Contract AF 19(604)-8419; ARPA Order 180-61; ARPA Order 292-62; Proj. Vela-Uniform)
(AFCRL-63-662)

Hugoniot equation-of-state data in the pressure range 5 to 250 kb have been obtained for quartzite, sandstone, calcite, marble, limestone, plagioclase, and basalt. The data were obtained by conventional shock-wave techniques which measure shock and associated free-surface velocities. Impedance match solutions were obtained for porous rocks. High values of the Hugoniot elastic limit were observed in solid rocks—50 to 100 kb in quartzite, 40 to 50 kb in feldspar and basalt, and 20 kb in calcite and marble. Porous rocks show considerably reduced values amounting to approximately 5 kb in sandstone and limestone. Four phase transitions, indicated by multiple shock fronts, are observed in calcite. No simple relation between these and the reported transitions observed in static experiments is evident. An indication of a phase transition in sandstone at 68 kb was also obtained and is interpreted as the quartz-stishovite transition. Decay of the elastic precursor wave amplitude, implying a time-dependent yield stress, is observed in quartzite, calcite, and marble.
Author

N63-20820 National Carbon Co., Lawrenceburg, Tenn. Advanced Materials Lab.
PYROLYTIC COATING OF CARBON FILAMENTS Quarterly Progress Report, May 15 to Aug. 15, 1963
R. M. Bushong Wright-Patterson AFB, Ohio, AF Materials Lab., Aug. 31, 1963 33 p
(Contract AF 33(657)-11297)

Methods for the deposition of pyrolytic carbon on the individual filaments of a carbon yarn on a continuous basis are presented. Increases in strength of the yarn due to the coating are shown to be a function of coating-chamber design, as well as a function of the process parameters of the filament temperature, filament velocity, and coating gas mixture. Carbon yarns have been produced with strengths as high as 300 percent of the starting material, and a depth of penetration has been achieved so that at least 60 percent of the filaments within a strand are coated. Author

N63-20826 Avco-Everett Research Lab., Everett, Mass.
A GRAPHITE INERT GAS HEATER FOR MHD STUDIES
J. Klepeis May 1963 14 p 1 ref
(Contract AF 04(694)-33)
(BSD-TDR-63-109; AMP-116)

This paper describes the design and construction of a graphite inert gas heater used for MHD studies at temperatures up to 2000° K. Heater performance and two methods for making the high-temperature inert gas electrically conductive are described. Author

N63-20852 Naval Ordnance Test Station, China Lake, Calif.
SURVEY OF OPTICAL MATERIALS
William R. Mc Bride and Allen L. Olsen *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14–15, 1960 p 5–32 40 refs (See N63-20851 21-13)

Results of investigations on the transmissive characteristics of optical materials in the range 2000 Å to 2μ are considered. The materials include miscellaneous glasses, films, single crystal and polycrystalline substances. The spectral traces serve to characterize these materials as wavelength discriminators or transmitters with emphasis on the ultraviolet and visible ranges. The absorption characteristics of several selective ultraviolet filters are described in detail. Author

N63-20853 Naval Research Lab., Washington, D.C.
OPTICAL POSSIBILITIES WITH CRYSTALLINE MATERIALS
Lewis R. Johnson *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14–15, 1960 p 33–45 6 refs (See N63-20851 21-23)

The possibilities of preparing single crystals which have optical properties to match predetermined specifications are considered under the three principal methods of modifying the basic properties of crystals: doping solid solution, and ligand change. Techniques are described for doping during crystal growth from solution, melt, and vapor, as well as doping by diffusion after growth. The modification of crystal properties by partial substitution of one or more ions during growth (growth of solid-solution single crystals) is described along with the appropriate crystal growing techniques. The third possibility, very powerful but little exploited, is the change of ligands. One promising example is the change from $NiSO_4 \cdot 6H_2O$ to $NiSO_4 \cdot 6NH_3$. Growth techniques which may be applied to such cases, and possible difficulties are outlined Author

N63-20907 Oak Ridge National Lab., Tenn.
REVIEW OF ELECTRONIC ABSORPTION SPECTRA OF MOLTEN SALTS
G. P. Smith Sept. 4, 1963 67 p 160 refs
(Contract W-7405-eng-26)
(ORNL-3411)

The results of investigations of electronic absorption spectra of molten salts are reviewed with the primary aim of providing a guide to the literature for those doing experimental research. The period covered is 1916 through mid-1962, with, however, most of the research concentrated on the period since 1956. Literature citations number 160 and include a large number of references to theoretical articles. The kinds of chromophores treated include transition-metal ions, lanthanide-metal ions, actinide-metal ions, halide ions, oxyanions, and solutions of metals and halogens in molten salts. Typical spectra are illustrated. The results of background theory necessary for interpretation of experimental results are given. Author

N63-20994 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
SUMMARY OF THE SEVENTH MEETING OF THE REFRACTORY COMPOSITES WORKING GROUP
W. A. Gibeaut and H. R. Ogden May 30, 1963 63 p
(Contract AF 33(616)-7747)
(DMIC-184)

Subjects covered include protective coatings, heat-resistant composites, dispersion strengthening, plasma spraying, and test procedures. Author

N63-21006 France. Ministere de l'Air, Paris
ANISTROPY AND EFFECT OF THE CUT [ANISOTROPIE ET EFFET D'ENTAILLE]
A. Brodeau Paris Service de Documentation et d'information Tech. de l'Aeron. (SDIT) [Aug. 1, 1962 24 p refs In FRENCH (*Its* Publ. Sci. et Tech., N.T.-115) Available from SDIT, 2, Ave. de la Porte d'Issy, Paris (15e)

The effect of the direction of the cut relative to the grain in wood is explained by experimental tension and compression results concerning anisotropy, elasticity, and plasticity. The obtained results are used to show that, in metals, the anisotropy plays hardly any role and the plasticity is the only important factor. Trans. by M.P.G.

N63-21013 Iowa State U. of Science and Tech., Ames. Ames Lab.
SOME OBSERVATIONS ON RARE EARTH SALTS OF TRICARBALLYLIC-ACID (PROPANE-1,2,3-TRICARBOXYLIC ACID). HYDRATION AND SOLUBILITY OF THE COMPOUNDS
Asim K. Gupta and Jack E. Powell July, 1963 13 p
(Contract W-7405-eng-82)
(IS-657) OTS: $0.50

Rare-earth tricarballylates were prepared by interaction of rare-earth chlorides and an equivalent amount of the disodium or trisodium salt of tricarballylic acid. Rare-earth tricarballylates precipitate immediately in cold. These were found to be very insoluble. Except for the lanthanum species, all the rare-earth compounds including yttrium tricarballylate were found to have a hydration number of four. Lanthanum alone was found to form a pentahydrate. A solubility study at two different temperatures (20° and 60° C), and a study of the thermal decomposition of the hydrates by means of a thermogravimetric balance were made which indicated that, though the "as prepared" rare-earth tricarballylate compounds, in general, have the same hydration, they decompose differently. Author

N63-21034 Rensselaer Polytechnic Inst., Troy, N.Y.
THE STRUCTURE OF NONLINEAR CELLULAR SOLUTIONS TO THE BOUSSINESQ EQUATIONS
Lee A. Segel Aug. 12, 1963 32 p 8 refs
(RPI-Math. 60)

A model equation is constructed whose analysis reveals the same features, including stable hexagonal cells, as analysis of genuine approximate equations for the thermal convection problem. Taking advantage of the relative simplicity of the calculations, an attempt is made to clarify certain procedures customarily used in nonlinear stability theory; in particular, the basis for the usual formal expansions and the appropriateness of neglecting terms of fourth and higher order are discussed. It is demonstrated that a whole class of equations lead to hexagonal cells, thereby giving confidence that results on convection cells found elsewhere in idealized situations will remain valid when more realistic situations are studied.
Author

N63-21070 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility

MEASURED EFFECTS OF THE VARIOUS COMBINATIONS OF NUCLEAR RADIATION, VACUUM, AND CRYOTEMPERATURES ON ENGINEERING MATERIALS Quarterly Progress Report, 1 Mar. 1963-31 May 1963

E. E. Kerlin and E. T. Smith June 28, 1963
(NASA Contract NAS8-2450, Mod. 3)
(NASA CR-50987; FZK-167) OTS: $7.60 ph, $2.42 mf

Progress was reported on a series of tests which were initiated to measure the effects of radiation, high vacuum, and cryotemperatures on a select group of nonmetallic spacecraft materials. Included were the combined effects of nuclear radiation and vacuum, the combined effects of radiation and cryotemperatures, and the combined effects of radiation, vacuum, and cryotemperatures. Materials tested included structural adhesives, structural laminates, potting compounds, electrical and thermal insulation materials, dielectric materials, and seals.
C.L.W.

N63-21117 General Dynamics/Fort Worth, Tex.

INVESTIGATION OF NEW UNCONVENTIONAL POLYMERIZATION TECHNIQUES AND DEVELOPMENT OF SEMI-INORGANIC BORON CONTAINING POLYMERS

J. P. Thomas Aug. 5, 1963 35 p 7 refs
(Contract AF 33(657)-11214)
(ERR-FW-124)

The present emulsion-polymerization processes for preparing large quantities of polymeric materials led to the hypothesis that unconventional techniques employed in this program might lead to higher molecular weight, and consequently, to semi-inorganic polymers with more elasticity and processability than presently known semi-inorganic polymers. Unconventional polymerization techniques studied, utilized molten zinc chloride, sulfur and Cerrobend alloy as reaction media, and Abitol, B-triphenylborozole, N,N' diallymelamine and dicyandiamide as reactants in various combinations in sealed, nitrogen-purged stainless-steel reaction tubes at temperatures up to 300° C. Two crosslinked polymeric materials resulted from the reaction of B-triphenylborazole and N,N' diallymelamine and dicyandiamide which did not melt at temperatures up to 300° C. The synthesis of B-trichloro-N-trimethylborazole was accomplished in approximately 10-percent yield. A monomer, B-triphenylborazole, synthesized in the laboratory was utilized in the synthesis of a polymeric material having a molecular weight of approximately 650. A glass-reinforced-plastic laminate which shows promise of exhibiting good thermal stability was prepared using a borazole modified epoxy novalac resin system and a vacuum-bag-type layup cure. Following a postcure of 260° C, the laminate exhibited a Barcol hardness of 65-70.
Author

N63-21163 Battelle Memorial Inst., Columbus, Ohio

FABRICATION AND PROPERTIES OF HOT-PRESSED URANIUM MONONITRIDE

Edward O. Speidel and Donald L. Keller May 30, 1963 69 p 28 refs
(Contract W-7405-eng-92)
(BMI-1633; EURAEC-706) OTS: $1.75

Dense UN specimens for property tests were fabricated primarily by an isostatic hot-pressing technique in which consolidated powder, sealed in a refractory metal container, was subjected to a 10,000-psi external gas pressure at 1480° to 1540° C for 3 to 4 hr. The thermal conductivity of uranium mononitride increased from 0.04 cal/cm sec° C at 200° C to 0.06 cal/sec cm^{2}° C at 1000° C, which by an integrated thermal-conductivity criterion, makes it some eight times more effective than UO_2 in transferring heat. Thermal-expansion coefficients of 9.0×10^{-6}/° C and 9.9×10^{-6}/° C over the ranges 20° to 800° C and 20° to 1600° C, respectively, were measured. UN retained about 80 percent of its room-temperature hardness at 1100° C. Above this temperature, the hardness dropped rapidly with increasing temperature. The specific heat in cal/g mole can be conveniently described by the equation $C_p = 13.32 + 1.19 \times 10^{-3} T - 2.10 \times 10^{5} T^{-2}$ over the range 273° to 1423° K. Electrical conductivity dropped with increasing temperature, a metallic characteristic. Anomalies were noted in attempts to measure the hydrogen solubility and the resistance to water corrosion. UN is apparently not attacked by NaK within 1500 hr at temperatures up to 480° C.
Author

N63-21168 IIT Research Inst., Chicago, Ill.

OPTICAL SPECTRA OF SOME LOW-MOLECULAR-WEIGHT COMPOUNDS USING THE MATRIX-ISOLATION TECHNIQUE Quarterly Technical Summary Report, May 14-Aug. 14, 1963

Alan Snelson Sept. 5, 1963 4 p 1 ref
(Contract DA-31-124-ARO(D)-111; ARPA Order 458)
(IITRI-C6013-1)

A molecular beam furnace, which utilizes copper-induction-coil heating, and a matrix-isolation glass cryostat were constructed and tested. A simple inert gas-collection and storage system was designed. The purity of collected gases was tested spectroscopically and found to be high. Suitable experimental conditions were established for the vaporization of the following compounds: aluminum fluoride, lithium–aluminum fluoride, lithium fluoride, beryllium fluoride, lithium–beryllium fluoride, and lithium metaborate. Samples of lithium metaborate enriched with Li^{6} and B^{10} were prepared by fusing lithium carbonate and boric oxide which were each enriched with the lighter isotopes. Analyses of the lithium content of these samples proved the required stoichiometry. A similar analysis of lithium–aluminum fluoride, prepared by fusing lithium fluoride, also showed the correct stoichiometry.
C.L.W.

N63-21172 Naval Radiological Defense Lab., San Francisco, Calif.

PRIMARY AND SECONDARY GRAIN DENSITIES OF HEAVY IONS IN INSENSITIVE EMULSIONS

H. H. Heckman (Calif. U., Berkeley) and E. V. Benton July 6, 1963 23 p 10 refs
(USNRDL-TR-657)

The grain densities of stopping C^{12}, O^{16}, and Ne^{20} ions have been measured as a function of velocity ($\beta \leq 0.145$) in insensitive Ilford emulsion types K minus 1 and K-0. The measurements were carried out using photomicrographic techniques. An exponential gap-length distribution is observed for gap lengths greater than 0.25 microns for rates of energy loss up to 2.35 Mev/micron. The composition of the grain density is

analyzed in terms of primary and secondary grain densities. It is concluded that the secondary grain density, which is due principally to δ-rays, accounts for about 35 percent of the total grain density observed in these insensitive emulsions. A generalized formula derived from these data expresses the observed grain density as a function of the particle velocity and charge, and the sensitivity of the emulsion. Author

N63-21203 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ISOTHERMS OF MONATOMIC SUBSTANCES AND THEIR BINARY MIXTURES XXV. IDEM OF DIATOMIC SUBSTANCES XXXI. "THE COMPRESSIBILITY OF HYDROGEN AND HELIUM GAS BETWEEN 90° AND 14°K."
F. P. G. A. J. van Agt and H. Kamerlingh Onnes June 26, 1963 18 p Transl. into ENGLISH by JPRS from Verslagen der Afdeeling Natuurkunde Akademie van Wetenschappen (Amsterdam), v. 34, 1925 p 625–637
(RSIC-30)

Investigation of the compressibility of hydrogen and gaseous helium near the boiling point of hydrogen was carried out in order to determine accurate values for the second virial coefficient in the empirical equation of state, $pv = A + Bd + Cd^2 + Dd^4 \ldots$ By means of the B values found, it was possible to calculate the corrections for converting the international hydrogen and helium thermometer scales to the Avogadro scale of the same gases. P.V.E.

N63-21207 Bureau of Mines, Salt Lake City, Utah
MODIFICATIONS IN BOMB REDUCTION OF VANADIUM OXIDE
C. J. Chindgren, L. C. Bauerle, and J. B. Rosenbaum 1963 18 p 21 refs
(BM-RI-6284)

Modifications of the conventional method of preparing ductile vanadium metal by calcium reduction of V_2O_5 in a bomb were explored for clues to a more economical procedure. The modifications examined included: (1) omitting the gas purge of the bomb ordinarily used for eliminating atmospheric nitrogen, (2) using low-grade vanadium feed materials, (3) using alternative reductants, such as aluminum, magnesium, and silicon, and reductant mixtures, and (4) bomb refining of aluminothermic metal produced in open-vessel reductions. The most promising modification appeared to be bomb refining, using calcium to purify vanadium metal—of low aluminum but high oxygen content—prepared by open-vessel aluminothermic reduction of vanadium pentoxide. Author

N63-21220 Raytheon Co., Waltham, Mass. Research Div.
INVESTIGATION OF THE MICROWAVE PROPERTIES OF FERROELECTRICS. THE ELASTIC CONSTANTS OF STRONTIUM TITANATE Scientific Report No. 5
R. O. Bell and G. Rupprecht Aug. 1962 22 p 13 refs
(Contract AF 19(604)-8005)
(AFCRL-62-594; S-456)

The elastic constants c_{11}, c_{12}, and c_{44} of single-crystal strontium titanate have been measured as a function of temperature from 300° K to 112° K by determining the velocity of an ultrasonic wave. At 112° K the strontium titanate undergoes a phase transition to a tetragonal structure which causes a marked change of the elastic properties and the appearance of a domain structure, but does not cause a discontinuity of the dielectric constant. The phase transition is free of hysteresis. The dependence of the elastic properties on a d-c electric field parallel to the velocity of sound propagation was measured and found independent of the dielectric properties. The implications of this result are discussed. Author

N63-21228 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THE VISCOSITY AND FLOW MECHANISM OF POLYMERS WITH DISPERSE FILLERS
G. M. Bartenev and N. V. Zakharenko Sept. 2, 1963 18 p 19 refs Transl. into ENGLISH from Kolloid. Zhur. (Moscow) v. 24, no. 2, 1962 p 121–127
(RSIC-51)

The viscosity and flow mechanism of polymers with disperse fillers were investigated. Conclusions reached include: (1) introduction of a disperse filler into a polymer leads to a drastic increase of viscosity without a change in its temperature coefficient, (2) the increase of viscosity by introducing small quantities of a disperse filler is related mainly to volumetric decrease of the polymer phase in the mixture, (3) the molecular flow mechanism of the filled mixtures is basically the same as that for pure polymers, and (4) the activation energy of viscous flow is invariant not only in stress and in the molecular weight of a polymer but also in the quantity of an active filler in the mixture. P.V.E.

N63-21229 Stanford U., Calif.
IRREVERSIBLE BEHAVIOR IN A RADIATING GAS
Jean-Pierre Guiraud May 1962 22 p
(Supported by NSF Grant)
(SUDAER-119)

This note demonstrates that the laws of radiation, considered from a continuous point of view have built into them an irreversible behavior, as should be the case from general considerations of thermodynamics. More precisely, we shall prove the following: Let (D) be a domain, bounded by a wall (Σ), and containing a radiating gas, to which radiation communicates the amount of heat $Q(\nu,\theta,\dot{M})\, d\nu d\theta d\dot{M}$ for a range of frequency $d\nu$, a range of directions $d\theta$, and a volume $d\dot{M}$. Then we have

$$\int_0^{\infty} d\nu \int_{|\theta|=1} d\theta \int_{(D)} d\dot{M}\, \frac{Q(\nu,\theta,\dot{M})}{T(\dot{M})} \geq \Phi$$

where Φ is the amount of entropy communicated to the gas by heating from radiation. It is either emitted by the wall or comes from the exterior world through transparency of the wall it is then absorbed inside (D) after possibly being reflected many times along the wall. Author

N63-21234 Rocketdyne, Canoga Park, Calif.
MECHANICAL AND PHYSICAL PROPERTIES OF FUSION WELDED INVAR 36 Progress Report
D. R. Miller and C. S. Shira Oct. 8, 1962 32 p
(MPTR-2-251-1)

Results of tests indicate that Invar 36 parent material has mechanical properties adequate for many applications involving cryogenic environment. The yield and ultimate tensile strength increased with lower temperatures to −423° F while retaining good ductility and notch impact strength. This indicates that the material does not undergo detrimental brittle transition at low temperatures that would cause serious in-service difficulties. The alloy possesses good weldability, and is capable of being fabricated by adequately qualified weldors without special training. Author

N63-21246 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
SOLUTE REDISTRIBUTION DURING SOLIDIFICATION OF EUTECTIC-FORMING MIXTURES

W. R. Wilcox July 22, 1963 29 p 11 refs
(Contract AF 04(695)-169)
(TDR-169(3240-10)TN-2; SSD-TDR-63-160)

Nearly all theoretical treatments of solute segregation during solidification assume a constant distribution coefficient. In general, however, only very dilute mixtures have a constant distribution coefficient. Mixtures of high concentration more typically exhibit eutectic behavior. In this paper, the problem of the progressive freezing of a simple eutectic-forming binary mixture from an infinite melt with pure diffusional mass transfer is solved by the method of Laplace transforms. Author

N63-21261 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
ZONE MELTING OF EUTECTIC-FORMING MIXTURES
W. R. Wilcox Aug. 21, 1963 29 p 8 refs
(ATN-64(9236)-2)

The problem of solute redistribution resulting from the zone melting of eutectic-forming mixtures has been solved analytically for pure, diffusional mass transfer. The solute distribution during the initial period (in which no solute is contained in the solid) was solved by the method of Laplace transforms. The final period (in which the solute concentration at the freezing interface remains fixed at the eutectic concentration) was solved by separation of variables. For a ratio of eutectic concentration to original solute concentration greater than 4, the solute-concentration profile in the solid during the final period was found to be independent of this ratio. Author

N63-21313 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EVALUATION OF CRITICAL PROPERTIES OF SELECTED MATERIALS FOR ELECTRONIC PACKAGING PURPOSES Final Report, 5 Mar. 1962-30 June 1962
Jay W. De Dapper Aug. 1, 1962 79 p
(NASA Contract NAS7-100)
(NASA CR-51244; JPL-RML-4) OTS: $7.60 ph, $2.57 mf

An extensive examination of selected mechanical, electrical, and physical properties of a group of commercially available polymeric materials, including epoxy and polyurethane coatings, adhesives, potting compounds, and foams, has been made under vacuum conditions of 10^{-4} to 10^{-6} torr and over a temperature range of $-40°$ F. to $+300°$ F. Not only were measurements made on samples after 24 hours exposure to the various combined environments, but also while the materials were in those environments. Comparative one-atmosphere values were also taken. In general, no catastrophic changes were noted in the properties of any of the materials measured in vacuum compared with their characteristic one-atmosphere values at equivalent temperatures. Increasing temperatures caused more noticeable changes in most cases than the short-time vacuum exposures. Equipment for the various tests is also described. Author

N63-21332 General Dynamics/Fort Worth, Tex.
INVESTIGATION OF COMBINED EFFECTS OF RADIATION AND VACUUM AND OF RADIATION AND CRYOTEMPERATURES ON ENGINEERING MATERIALS. VOLUME II: RADIATION-CRYOTEMPERATURE TESTS Annual Report, 9 November 1961-8 November 1962
E. T. Smith Jan. 5, 1963 261 p 9 refs
(NASA Contract NAS8-2450)
(NASA CR-31140; FZK-161-2) OTS: $17.00 ph, $8.03 mf

The materials tested were adhesives, seals, thermal insulations, electrical insulations, structural laminates, and thermal-control coatings. Typical tests performed on specimens prepared from the materials included lap-shear strength, ultimate tensile strength, ultimate elongation, stress–strain characteristics, and compressive strength. Special test equipment to submerge the specimens in liquid nitrogen or liquid hydrogen during irradiation was designed and built. Measured properties of the materials as a function of integrated neutron flux and gamma dose are reported, and recommendations for use of the various materials in nuclear-powered spacecraft are made. Author

20 MATHEMATICS

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

N63-20750 RAND Corp., Santa Monica, Calif.
TWO NOTES ON THE LOGNORMAL DISTRIBUTION
Milton Kamins Aug. 1963 30 p 16 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3781-PR)

This memorandum presents information and discussion about two previously unexplored aspects of lognormal distribution. The first aspect concerns applications of lognormal distribution in the simulation of queueing problems. A simple method for simulating a truly random series of observations from a particular lognormal population is described; an example is given in FORTRAN. The second aspect discussion is an analysis of one feature of the lognormal distribution of times-to-failure—a peak in the failure rate. It provides information concerning the age at which peak occurs, its magnitude, and certain related asymptotic properties. E.K.R.

N63-20773 Aerospace Information Div., Library of Congress, Washington, D.C.
APPLICATION OF CHEBYSHEV POLYNOMIALS IN THE CALCULATION OF STEP TRANSITIONS [PRIMENENIYE POLINOMOV CHEBYSHEVA DLYA RASCHETA STUPENCHATYKH PEREKHODOV] Report 2
Ya. M. Turover and N. I. Strutinskiy Aug. 9, 1963 33 p 17 refs
Transl. into ENGLISH from Radiotekhn. i elekt. (Moscow), v. 1, no. 2, Feb. 1956 p 143–161
(AID T-63-105) OTS: $3.60 ph, $1.19 mf

A method of calculating step transitions in transmission lines through the use of Chebyshev polynomials of the first kind is proposed. The advantage with this method is the greater gain and smoothness of transitions at given transition length and overlap coefficient, than with binomial transitions. The proposed calculation method ignores local waves at the junctions between the steps and does not take into account repeated reflections. The theory is illustrated by a series of graphs and some numerical examples. Brief information on Chebyshev polynomials of the first kind is also given. Author

N63-20788 Belfour Engineering Co., Suttons Bay, Mich.
DEVELOPMENT OF A MATERIALS PROPERTY DATA PROCESSING SYSTEM Final Report, Mar. 15, 1960-Aug. 31, 1962

R. C. Braden and C. S. Wright Wright-Patterson AFB, Ohio. Directorate of Mater. and Processes, Jan. 1963 176 p 82 refs
(Contract AF 33(616)-7238)
(ASD-TDR-63-128)

This report discusses a mechanical-properties information system, including the operation of a fatigue-of-metals subsystem, and the design-development and initial operation of other mechanical properties subsystems. These subsystems, employing punched-card equipment and techniques, actively provide mechanical-properties data and associated descriptive information of metals and reinforced plastics. Formats, codes, and procedures utilized to store, retrieve, and display mechanical properties of these materials are outlined. Author

N63-20802 Air Force Cambridge Research Labs., Bedford, Mass.
ON THE MINIMAL COVERING PROBLEM
S. R. Petrick June 1963 36 p 20 refs
(AFCRL-63-148)

This paper presents several algorithms for determining those irredundant and minimal clauses that imply a truth function given in conjunctive normal form. Algebraic methods of directly obtaining all minimal clauses or just a single minimal clause are given for use in those cases in which the entire set of irredundant clauses is not required. Programs using the LISP and COMIT Programming Systems and two basic machine codes have been written to evaluate the algorithms of this paper, relative to each other and to alternative procedures. Author

N63-20825 Rocketdyne, Canoga Park, Calif.
SOME RESULTS ON DESIGNS FOR REGRESSION EXPERIMENTS, DESIGN OF EXPERIMENTS WITH AUTOCORRELATED ERRORS PRESENT, AND DECISION THEORY APPROACH TO COMPLEX EXPERIMENTATION
M. J. Alexander, N. R. Goodman, M. O. Locks, and S. R. Webb Wright-Patterson AFB, Ohio, Aeron. Res. Labs., June 1963 62 p 8 refs
(Contract AF 33(616)-7372)
(ARL-63-107)

Results of research in the statistical design of complex experimental programs are reviewed. Included are discussions of the loss function methods for determining regression designs to minimize cost and variance, the design of experiments with autocorrelated errors, and applications of decision theory and dynamic programing to the design of reliability-growth programs. Author

N63-20886 Naval Research Lab., Washington, D.C.
DATA REDUCTION AND ANALYSIS
Robert Belsheim *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 1962 44 p 13 refs (See N63-20876 21-33)

The different kinds of motion data are discussed, and meaningful methods of reducing this data to provide information suitable for design and test usage are described. Vibratory, transient, and random motions resulting from dynamic loads are considered; further, each of these motions may be measured as a displacement, a velocity, or an acceleration. Examples are given of preliminary analyses of velocity-time records, acceleration-time traces, and complex mixtures of motion data such as are derived during the flight of a four-stage rocket vehicle. The purposes of the preliminary analysis are to determine the "goodness" of the raw data, to read off certain important quantities for immediate use, and to determine what kinds of additional analyses will be required. The four types of spectra which are useful for subsequent analysis of dynamic motion data are defined. Several examples are given to illustrate the usual kinds of final data analysis for particular load situations; however, the methods demonstrated are adaptable for other load situations. The importance of mechanical impedance concepts in assembling the data for design or test levels is considered. M.P.G.

N63-20889 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
TABLE OF $_2F_1$ (a,b;c;z) FOR a = 0(1/2)7, b = 0(1/2)7, AND c = 0(1/2)5/2 WITH COMMENTS ON CLOSED FORMS OF $_2F_1$ (a,b;c;z)
K. David Steidley Washington, NASA, Sept. 1963 28 p 12 refs
(NASA TN D-1735) OTS: $0.75

A table of Gauss' hypergeometric function $_2F_1$ (a,b;c;z) has been constructed that displays the analytic form for all integer and half-integer combinations from 0 to 7 of the parameters a and b, and 0 to 5/2 of c. In addition, a table is provided that gives the hypergeometric function in closed form for certain general relations among a, b, and c. Also shown is a simple function of $_2F_1$ (a,b;c;z) that yields all the classical orthogonal polynomials in algebraic form. Author

N63-20909 C-E-I-R, Inc., Beverly Hills, Calif.
TEST CRITERIA FOR PEARSON TYPE III DISTRIBUTIONS
M. R. Mickey, P. B. Mundle, D. N. Walker, and A. M. Glinski Wright-Patterson AFB, Ohio, Aeron. Res. Labs., June 1963 116 p 16 refs
(Contract AF 33(657)-7900)
(ARL-63-100)

Goodness-of-fit tests for the family of Pearson Type III distributions, and certain subfamilies, are investigated. A generally applicable computer program to calculate the large-sample distribution of the parametric Cramér-von Mises statistic for an efficient estimator is developed and applied to the Pearson Type III distribution, the gamma distribution, and the exponential distribution. The large-sample distribution theory is extended, and theoretical results on additional goodness-of-fit tests are derived. Results of sampling experiments are presented to indicate the appropriateness of the tabulated large-sample results to samples of moderate size, and sensitivity to the particular form of the estimators used. Results of sampling experiments are presented to indicate the low efficiency of the Pearson criterion K for testing whether a sample has been drawn from a Pearson Type III distribution. Author

N63-20911 Carnegie Inst. of Tech., Pittsburgh, Pa.
ON THE COMPARISON OF THE MEANS OF TWO POPULATIONS WITH UNKNOWN VARIANCES [Final Report, Sept. 1961-June 1962]'.
Ying Yao (Ph.D. Thesis) Wright-Patterson AFB, Ohio, Aeron. Res. Labs., June 1963 60 p 49 refs
(Contract AF 33(616)-8234)
(ARL-63-106)

This is a study of the comparison of the means of two populations with unknown variances using the method of approximate degrees of freedom. A modified version of the Welch method is given for the univariate situation, and an extension is given for the general multivariate situation. These methods are then compared with the asymptotic series solution with respect to their significance levels. Author

N63-20913 Wolf Research and Development Corp., West Concord, Mass.
INVESTIGATION OF SPACE PROBE DATA CONDITIONING AND REDUCTION METHODS Final Report

Daniel B. Brzezenski, Jerome Cohn, Donald Morrison, and James Sexton June 20, 1963 68 p
(Contract AF 19(628)-1611)
(AFCRL-63-842)

The digitizing equipment is described. The magnetic tape formats used by FORTRAN are described. Sample FORTRAN statements are given that are sufficient to read the magnetic tapes generated. The program flow charts are illustrated with descriptions of the program logic, and the pertinent operating instructions. Author

N63-20923 Northwestern U., Evanston, Ill. Technological Inst.
NOTES ON LINEAR INEQUALITIES. I: THE INTERSECTION OF THE NONNEGATIVE ORTHANT WITH COMPLEMENTARY ORTHOGONAL SUBSPACES
Adi Ben-Israel (Israel Inst. of Tech., Haifa) July 1963 14 p 20 refs
(Contract Nonr-1228(10))
(ONR-RM-78)

The intersections of the nonnegative orthant in E^n with pairs of complementary orthogonal subspaces are investigated. Applications to linear inequalities and linear programing are then made by using Fredholm's alternative theorem. Author

N63-20924 Northwestern U., Evanston, Ill. Technological Inst.
NOTES ON LINEAR INEQUALITIES, II: THE GEOMETRY OF SOLVABILITY AND DUALITY IN LINEAR PROGRAMMING
Adi Ben-Israel (Israel Inst. of Tech., Haifa) Aug. 1963 10 p 16 refs
(Contract Nonr-1228(10))
(ONR-RM-80)

Solvability and boundedness criteria for dual linear-programing problems are given in terms of the problem data and the intersections of the nonnegative orthant, with certain complementary orthogonal subspaces. Author

N63-20942 General Dynamics Corp., San Diego, Calif. General Atomic Div.
GAMBLE: A PROGRAM FOR THE SOLUTION OF THE MULTIGROUP NEUTRON-DIFFUSION EQUATIONS IN TWO DIMENSIONS, WITH ARBITRARY GROUP SCATTERING, FOR THE IBM-7090 FORTRAN II SYSTEM
J. D. Dorsey June 15, 1963 43 p 6 refs
(GA-4246)

GAMBLE is an IBM-7090 FORTRAN II chain program that finds, over a nonuniform rectangular mesh imposed upon a rectangular area of either the x-y or the r-z plane, a discrete numerical solution to the multigroup, time-independent, neutron-diffusion equations for a heterogeneous reactor. The solution is obtained over as many as 300 macroscopic determining regions, with or without a criticality search, using from one to ten lethargy groups and group-dependent, mesh-point limits of from 2000 to 8000 mesh points. The problem may be specified with both internal and external logarithmic derivative boundary conditions and with general group scatter. The program provides for the use of the multiplication factor and an output tape containing the pointwise flux solution from a previous GAMBLE computer run to be used as an input estimate. It also provides a restart procedure that enables the user to obtain the solution over many different computer runs. P.V.E.

N63-20964 Massachusetts Inst. of Tech., Cambridge Electronic Systems Lab.
ANALOG-DIGITAL COMPUTERS FOR REAL-TIME SIMULATION Technical Report
Mark E. Connelly Feb. 19, 1962 121 p 55 refs
(Contract N61339-594)
(NAVTRADEVCEN-594-1)

The relative advantages of analog and digital computational techniques as applied to the problem of real-time aircraft simulation are discussed. The hypothesis is presented that a basic digital computer is technically feasible today that would compete with analog techniques on the basis of both cost and the ability to simulate natural aircraft frequencies in real time. The concept of high-speed, time-shared analog computing elements operating under the control of a digital computer is introduced. A family of such elements is described, as well as various system design studies and experimental demonstration systems. The design of an analog-digital computer utilizing the pulsed-analog concept is outlined with emphasis on the problems of selecting an efficient order code and a suitable word length and word structure. It is concluded that the use of peripheral pulsed-analog equipment would increase the effective computing speed of a given digital computer on simulation problems by a factor of two or more. Author

N63-21037 Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
PROCESSING OF ALPHANUMERIC DATA IN FORTRAN
Barbara B. Occhipitini June 1963 45 p 1 ref
(Contract AT(07-2)-1)
(DP-822) OTS: $1.00

Programs are developed for handling alphanumeric data in FORTRAN. Such programs save coding time and facilitate transfer of programs from one machine to another. A program for periodic reporting of chemical analyses is given as an example. Author

N63-21047 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SEQUENTIAL ESTIMATION OF CORRELATED STOCHASTIC VARIABLES
C. G. Pfeiffer July 1, 1963 14 p 6 refs
(NASA Contract NAS7-100)
(NASA CR-50965; JPL-TR-32-445) OTS: $1.60 ph, $0.80 mf

A technique is developed for estimating the components of the sequence of correlated random vectors $\{X_1, \ldots, X_n, \ldots\}$, when given the sequence of linearly related data vectors $\{\phi_1, \ldots, \phi_n, \ldots\}$. It is shown that a necessary and sufficient condition that the minimum variance estimate of X_n depends only upon ϕ_n and the previously computed estimate of X_{n-1} is that all X_1 be "sequentially correlated." This is a condition placed upon the covariance matrix describing the otherwise unspecified physical process that generates the X_1. Examples of sequentially correlated processes are given, and an application to the deep-space orbit determination problem is discussed. Author

N63-21069 Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
ADAPTIVE STATE VECTOR CONTROL. SECTION 8: A LOGICAL NET MECHANIZATION FOR TIME-OPTIMAL REGULATION
F. B. Smith, Jr. July 31, 1962 38 p 12 refs
(NASA Contract NASr-27)
(NASA CR-50274; MH-MPG-1529-TR8) OTS: $3.60 ph, $1.37 mf

A technique is described for mechanizing relay controllers. A quantized phase space for the plant is mapped into two or more points by a collection of logic elements whose Boolean inputs are the quantized variables. If the switching surfaces are known explicitly, the logic (the mapping function) of the controller may be computed in a straightforward manner. If the surfaces are known only implicitly, the logic may be adjusted on a representative collection of particular values of the desired mapping function. Experimental results are presented for time-optimal control of third-order and fourth-order plants.
Author

N63-21085 Joint Publications Research Service, Washington, D.C.
SOVIET RESEARCH IN DATA PROCESSING
Aug. 15, 1963 267 p 95 refs Transl. into ENGLISH of 13 articles from various Russian-language Physico-Mathematical Publications, 1961–1962
(JPRS-20660; OTS-63-31540) OTS: $4.00

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12. APPLICATION OF COMPUTER TECHNIQUES IN DETERMINATION OF THE DYNAMIC CHARACTERISTICS OF CONTROLLED PROCESSES DURING THEIR NORMAL OPERATION V. V. Solodornikov and A. S. Uskov p 224–257 24 refs (See N63-21097 21-20)

13. SOMMERFELD'S POLYNOMIAL METHOD S. A. Smolyanskiy p 258–263 4 refs

N63-21086 Joint Publications Research Service, Washington, D.C.
VARIATIONAL PROBLEMS IN THE OPTIMIZATION OF CONTROL PROCESSES
V. A. Troitskiy *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 1–24 15 refs Transl. into ENGLISH from Prikl. Matemat. i Mekh., USSR, v. 26, no. 1, 1962 p 29–38 (See N63-21085 21-20) OTS: $4.00

The Mayer–Bolts problem in the optimization of control processes by the calculus of variations is considered. The limitations which are placed on the controls by problems of optimization are studied, and all essential conditions of the minimum are considered. The normal curves in the n + m-dimensional of the coordinates and controls which impart a minimum to the functional J are derived for the condition of the stationariness of functional J, the necessary condition of Weierstrass, the necessary condition of Klebsh, and the necessary conditions of Jacobi.
M.P.G.

N63-21087 Joint Publications Research Service, Washington, D.C.
PECULIARITIES OCCURRING UPON THE INTRODUCTION OF A SMALL PARAMETER IN INVESTIGATING NON-LINEAR OSCILLATIONS IN AUTOMATIC SYSTEMS
Ye. P. Popov *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 24–41 3 refs Transl. into ENGLISH from Prikl. Matemat. i Mekh., USSR, v. 26, no. 1, 1962 p 62–69 (See N63-21085 21-20) OTS: $4.00

The problem of a small parameter in equations of the dynamics of nonlinear automatic systems is stated in such a way that it apparently can be applied to the development of a mathematically strict basis for the widely used approximate methods of investigating automatic systems which have strong nonlinearities. In many automatic systems, the variable x goes in under the sign of nonlinearity although in practice the solution for x is close to linear, since it is associated with processes which are observed to be periodic or damped. A periodic solution for the variable x of the form

$$x = x_1 + \epsilon z(t) \quad (x_1 = A_1 \sin \Omega_1 t)$$

is constructed for the homogeneous equation

$$Q(p)\, x + R(p)\, y = 0,\ y = F(x, px) \qquad (1)$$

where Q(p) and R(p) are operator polynomials with constant coefficients and strong nonlinearity exists. A condition is found which corresponds to the property of a filter of the linear part of this equation. The periodic solution is found to be basic to all published methods of calculating auto-oscillations in nonlinear automatic systems for the first harmonic using harmonic linearization, harmonic balance, or circumscribing functions. Finally, an approximate expression which actually reflects the finite higher harmonics, despite their smallness, by the variable x is derived for equation (1). This calculational method makes possible the consideration of the influence of vibrational and random interference on the quality of operation of automatic control systems.
M.P.G.

N63-21088 Joint Publications Research Service, Washington, D.C.
SYNTHESIS OF A LINEAR SYSTEM OF AUTOMATIC CONTROL, WITH RESTRICTED DISPLACEMENTS OF CONTROLLING DEVICES, BASED ON THE CRITERION OF MINIMAL SQUARE DEVIATION AT THE GIVEN INSTANT
K. Shtaydten *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 42–62 4 refs Transl. into ENGLISH from Prikl. Matemat. i Mekh. USSR, v. 26, no. 1, 1962 p 70–79 (See N63-21085 21-20) OTS: $4.00

A dynamic system is considered which is described by the equation

$$x(t) = s(t) - \int_{O_1}^{t} h(t,\tau)y(\tau)d\tau$$

in which x(t) is a column of coordinates of the system; s(t) is a column of given random values which characterize the external actions and condition of the system at an initial moment of time t = 0; y(τ) is a column of coordinates of control organs; and h (t,τ) is the given matrix. The problem is posed of finding $y(t) \in L(t) (0 \leq t \leq T)$, for which the mean quadratic deviation of the system from the given positional x_T at the given moment of time >0 will be minimal. (The control actions y(t) are formed from the given vector column ρ and from the values in the interval of time $0 \leq \tau \leq t$ of the given random vector column r (τ) as the sum of two linear operators over ρ and r (τ). The set of all the random vector columns obtained in this way is designated L (t). The general solution of this problem is obtained, and the results are applied to the synthesis of a linear system of automatic control with restricted displacements of controlling devices. M.P.G.

N63-21089 Joint Publications Research Service, Washington, D.C.

THE PRINCIPLE OF THE EXTREMUM FOR A SYSTEM OF SECOND-ORDER DIFFERENTIAL EQUATIONS

V. Ya. Skorobogat'ko *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 63–83 5 refs Transl. into ENGLISH from Sibirskiy Mat. Zhur. Moscow, v. 2, no. 5, Sept.–Oct. 1961 p 746–758 (See N63-21085 21-20) OTS: $4.00

Laplace's equation Δu = 0 is considered in some region D with the boundary S. A geometric approach to the fact that a continuous solution of this equation takes its minimum and maximum value on the boundary S is used to demonstrate the principle of the extremum: if some point $P^* \epsilon S^*$ can relate a reference plane *l* to the set D*, then one of the images P of such a point P* belongs to the boundary S of region D. This principle of the extremum is developed for the system of differential equations

$$L\left(x, \frac{\delta}{\delta x}\right) u = 0.$$

Since, in concrete systems, not all points $P^* \epsilon S^*$ which can relate to the plane *l* from outside have images $P \epsilon S$, systems of differential equations for which the principle of the extremum is valid are sought. The necessary conditions for an extremum are developed, and theorems for the principle of the extremum for certain second-order systems, for the static system of equations in elasticity theory, and for more general systems of second-order equations are proven. Level surfaces for solutions of a second-order system are formulated, and the principle of the extremum for nonstationary systems of second-order equations is developed. M.P.G.

N63-21090 Joint Publications Research Service, Washington, D.C.

ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF A MANY-DIMENSIONAL SYSTEM OF DIFFERENTIAL EQUATIONS HAVING A SINGULAR POINT OF HIGHER ORDER

A. A. Shestakov *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 84–120 10 refs Transl. into ENGLISH from Sibirskiy Mat. Zhur. Moscow, v. 2, no. 5, Sept.–Oct. 1961 p 767–788 (See N63-21085 21-20) OTS: $4.00

The problem of the existence of families of O^+ and O^- curves in a many dimensional system of ordinary differential equations of the form

$$\frac{dx}{dt} = X(x); X(O) = O; O = (O, \ldots, O)$$

is investigated for the case when the coordinates $X_s(x)$ (s = 1, ... n) of a n-dimensional vector function X(x) of the point x = $(x_1, \ldots x_n)$ are power series in powers of the coordinates x_s of the point x; while, at the same time, these series lack absolute terms and first-degree terms. First, systems in which the right hand sides of the equations are forms of the same degree are considered, and then an analogous problem is examined in the general case for analytic functions. M.P.G.

N63-21091 Joint Publications Research Service, Washington, D.C.

A METHOD FOR NUMERICAL INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS

O. K. Daugavet *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 121–128 3 refs Transl. into ENGLISH from Sibirskiy Mat. Zhur. Moscow, v. 2, no. 5, Sept.–Oct. 1961 p 792–796 (See N63-21085 21-20) OTS: $4.00

Numerical integration of certain types of systems of differential equations, based on the prior determination of the behavior of the solution and its derivatives in the neighborhood of some point or on some interval, is discussed. The Cauchy problem for a system of ordinary differential equations is considered. Formulas for the approximate integration of the problem are developed, using the Adams method and also using a special form of constructed quadrature formulas. In the latter method, if y_i' (i = 1,2, ...,n) is approximated by linear combinations of functions ϕ_j, then the coefficients of the desired quadrature formula can be found from a system of *l* + 1 linear algebraic equations. Special cases are studied where it is possible to avoid the *l* + 1 procedure by establishing the proximity of the solutions of a given equation and some other linear equation with constant coefficients. In these cases, the constructed quadrature-formula method consistently gave smaller errors than the Adams method for numerical integration of ordinary differential equations. M.P.G.

N63-21092 Joint Publications Research Service, Washington, D.C.

THE NUMERICAL SOLUTION OF INTEGRO-DIFFERENTIAL EQUATIONS WITH A QUASI-LINEAR DIFFERENTIAL OPERATOR AND THE GENERALIZED VOLTERRA OPERATOR

G. B. Linkovskiy and V. F. Krapivin *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 129–133 1 ref Transl. into ENGLISH from Sibirskiy Mat. Zhur. Moscow, v. 2, no. 5, Sept.–Oct. 1961 p 797–800 (See N63-21085 21-20) OTS: $4.00

An approximate method for numerical solution of integro-differential equations is proposed, which is based on replacing it on each partial interval by an easily-integrated ordinary differential equation with constant coefficients. The recurrent and the total estimates of the error of this approximate integration method are given. M.P.G.

N63-21093 Joint Publications Research Service, Washington, D.C.

PARAMETER DEPENDENCE OF THE SOLUTIONS OF DIFFERENTIAL DIFFERENCE EQUATIONS

V. P. Rubanik *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 134–139 3 refs Transl. into ENGLISH from Sibirskiy Mat. Zhur. Moscow, v. 2, no. 6, Nov.–Dec. 1961 p 904–912 (See N63-21085 21-20) OTS: $4.00

A theorem of the continuous dependence of the solutions of differential difference equations on a parameter is formulated

which is more general and less cumbersome than the "method of steps" of Myshkis. In proving this theorem, the method of Krasnosel'skiy and Kreyn for ordinary differential equations is used. A second theorem, obtained as a consequence of the first theorem, provides the basis for the applicability of the principle of averaging to nonlinear differential difference equations and is a generalization of the Bogolyubov theorem for ordinary differential equations. Theorem 2 is proven to be a corollary of theorem 1, and, on this basis, the analytical dependence of the solutions of differential difference equations on a parameter is proven. M.P.G.

N63-21094 Joint Publications Research Service, Washington, D.C.

A BOUNDARY VALUE PROBLEM AND CERTAIN QUESTIONS OF THE VARIATION OF ITS SOLUTIONS

V. P. Skripnik. *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 150-191 2 refs Transl. into ENGLISH from Mat. Sb. Moscow, v. 55 (97), no. 4 1961 p 449-472 (See N63-21085 21-20) OTS: $4.00

Given a system of m equations

$$\left.\begin{aligned} x'_1 &= f_1(t, x_1, \ldots, x_m), \\ &\cdots\cdots\cdots\cdots \\ x'_m &= F_m(t, x_1, \ldots, x_m) \end{aligned}\right\}$$

in the interval [a,b], the following boundary-value problems are investigated: first, to find a continuous solution in x for [a,b] such that $x_i(a_i) = \alpha_i$, where $i = 1, \ldots, m$, $a_i \in [a,b]$; second to find a continuous solution for x for [a,b] such that $x_j(a_j) = \alpha_j x_j(b_j) = \beta_j x_k(c_k) = \gamma_k$, where $j = 1, \ldots, l$; $k = l+1, \ldots, l+p$; $2l+p = m$, $a_j \in [a,b]$, $b_j \in [a,b]$, $c_k \in [a,b]$; third, to examine questions of variations of solutions of nonlinear equations of the second order and show that the spread between zeroes of any nontrivial solution in x is the larger of some positive integer; and fourth, to establish a relation between the existence of a solution of the boundary-value problem type $x(\tau_1) = \alpha$, $x(\tau_2) = \beta$, where $\tau_1, \tau_2 \in [a,b]$, and variation of solutions at [a,b] for a homogeneous, linear differential equation of the second order. M.P.G.

N63-21095 Joint Publications Research Service, Washington, D.C.

A GENERAL SOLUTION OF THE PROBLEM OF MOTION OF A HEAVY SOLID BODY AROUND A FIXED POINT

A. N. Filatov. *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 192-210 2 refs Transl. into ENGLISH from Izvest. Akad. Nauk SSR, (Ser. of Physico Math. Sci. SSR) Tashkend, no. 6, 1961 p 23-33 (See N63-21085 21-20) OTS: $4.00

A general solution is derived for the system of differential equations describing the motion of a heavy, solid body which has one fixed point. The general solution is proven by the method of inequalities and by direct substitution. The application of the general solution to obtain all the known integrals of the initial system of motion equations is demonstrated by (1) obtaining the integral of kinetic energy and the integral of the moments of momentum and geometric relation; (2) obtaining the fourth integral in the Euler-Poinsot case, the Lagrange-Poisson case, the Kovalevskaya case, the Bobylev-Steklov case, the Goryachev-Chaplygin case, and the Gess-Appel'rot case. M.P.G.

N63-21096 Joint Publications Research Service, Washington, D.C.

STATISTICAL AND PROBABILITY SIMULATION AS A POSSIBLE PRINCIPLE OF CONSTRUCTING CONTROL SYSTEMS

V. V. Chavchanidze. *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 211-224 19 refs Transl. into ENGLISH of an article from the book "Nauchno-Teknicheskoye Obshchestvo Priborostroitel'noy Promyshlennosti. Primeneniye Vychislitel'noy Tekhniki Dlya Avtomatizatsii Proizvodstva." Moscow, 1961 p 52-62 (See N63-21085 21-20) OTS: $4.00

The principles of building control systems based on the method of statistical-probability (or stochastic) simulation are discussed. This method is based on the Monte Carlo method, which is described briefly. The use of a random test method (consisting of drawing random values to replace, step by step, the probability unknowns of the next test in the series), to expedite the Monte Carlo calculations is demonstrated. The advantages of the Monte Carlo method in statistical-probability simulation over digital and other analytic methods are discussed. The features of statistical-probability simulation are examined; these include the possibility of simulating processes in which a set of objects or signals simultaneously participate and serve as the cause of subsequent stochastic processes and structures, and also the possibility of modeling in accordance with the process in time on the natural scale with consideration of the natural lag of the output behind the input. Applications of the reverse Monte Carlo method in statistical-probability simulation are summarized. The construction of a statistical-probability self-simulating machine capable of reproducing the features of technical, technological, or physical processes, regardless of their complexity, is proposed. M.P.G.

N63-21097 Joint Publications Research Service, Washington, D.C.

APPLICATION OF COMPUTER TECHNIQUES IN DETERMINATION OF THE DYNAMIC CHARACTERISTICS OF CONTROLLED PROCESSES DURING THEIR NORMAL OPERATION

V. V. Solodovnikov and A. S. Uskov. *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 224-257 24 refs Transl. into ENGLISH of an article from the book "Nauchno-Tekhnicheskoye Obshchestvo Proborostroitel'noy Promyshlennosti. Primeneniya Vychislitel'noy Tekhnika Dlya Avtomatizatsii Proizvodstva" Mashgiv, Moscow, 1961 p 458-482 (See N63-21085 21-20) OTS: $4.00

Statistical methods for accurately determining the dynamic characteristics of complex automated industrial processes with multiple inputs and outputs and with feedback and extraneous internal signals are discussed, and the functions that must necessarily be incorporated in a machine to control these automated processes are examined. M.P.G.

N63-21098 Joint Publications Research Service, Washington, D.C.

SOMMERFELD'S POLYNOMIAL METHOD

S. A. Smolyanskiy. *In its* Soviet Res. in Data Processing Aug. 15, 1963 p 258-263 4 refs Transl. into ENGLISH from "Izv. Vysshikh Uchebn. Zavedenii-Fix.," Tomsk USSR no. 4, 1961 p 12-16 (See N63-21085 21-20) OTS: $4.00

A general unidimensional Schroedinger equation and its solution by Sommerfeld's polynomial method are given. This general form of the Schroedinger equation can be used to judge the applicability of the polynomial method to particular Schroedinger equations. The eleven coordinate systems for separating the variables of a three-dimensional, time-independent Schroedinger equation are tabulated, and their use in the general equation is demonstrated. The results obtained for the three-dimensional coordinate systems contain, as particular instances, conclusions applicable to a two-dimensional, time-independent Schroedinger equation. M.P.G.

N63-21197 North American Aviation, Inc., Downey, Calif.
THE N-BODY PROBLEM: A SURVEY Annotated Bibliography [of International Literature, 1940-1960]
Feb. 20, 1963 71 p 192 refs
(SID 63-157)

This report is an annotated bibliography of international literature, 1940-1960, on the n-body problem. Author

N63-21206 Argonne National Lab., Ill. Applied Mathematics Div.
AN INFORMATION-THEORETICAL MODEL APPLIED TO COMPUTER PROGRAMS
W. R. Cowell June 1963 20 p 5 refs
(Contract W-31-109-eng-38)
(ANL-6722)

A mathematical model is discussed which was developed to describe the match between a message and a communication channel. Also, the model is interpreted so as to describe the match between a particular computation and a given instruction repertoire for a computer. To exemplify and experiment with these concepts, a series of measurements which were made with IBM 704 programs are described. I.v.L.

N63-21241 RAND Corp., Santa Monica, Calif.
A DIFFERENTIAL GAME WITHOUT PURE STRATEGY SOLUTIONS ON AN OPEN SET
Leonard D. Berkovitz Feb. 1962 32 p 3 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3012-PR)

In this memorandum, an example is given of a differential game with integral payoff and continuous terminal payoff that does not have a pure strategy solution. The methods and results of a previous report are used to establish the nonexistence of pure strategies. Author

N63-21255 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
PROCESSING OF RANDOMLY FLUCTUATING DATA BY ANALOG ANALYSIS METHODS
C. H. v.d. Linden Mar. 1962 70 p 28 refs
(Performed under contract with the Netherlands Aircraft Develop. Board (N.I.V.)
(NLR-TN-V.1895)

A number of analog data reduction possibilities for random-type signals are reviewed with respect to the determination of amplitude probability distributions, power spectrum, and cross power spectrum. A number of computation schemes and equipment required are discussed. Error sources and accuracy aspects are considered in some detail. Author

N63-21282 Lincoln Lab., Mass. Inst. of Tech., Lexington
DATA SYSTEMS Quarterly Progress Report [May 1-July 31, 1963]
C. R. Wieser, S. H. Dodd, and F. C. Frick Aug. 28, 1963 20 p 15 refs
(Contract AF 19(628)-500)

Progress is reported in the following areas: (1) digital computers—computer systems, applications, circuit development, and magnetic-film engineering; (2) computer components—electron transport in films, magnetic films, and advanced circuits; (3) psychology—automatic speech recognition and human information processes; (4) control research—digital systems design, estimation and control, and data systems design. P.V.E.

21 METEOROLOGY

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N63-20732 Air Force Cambridge Research Labs., Bedford, Mass. Geophysics Research Directorate
TRANSFORMATION OF THE EQUATIONS OF MOTION OF METEOROLOGY INTO ARBITRARY ORTHOGONAL COORDINATES Research Report
Eugene M. Luks (Regis Coll.) Dec. 1962 16 p 5 refs
(Contract AF 19(604)-7247)
(AFCRL-62-1109)

The earth is usually represented in cartesian coordinates on a projection plane with the atmosphere mapped three-dimensionally. Most such maps are orthogonal, and in this case, the equations-of-motion take a particularly simple form. Author

N63-20903 Joint Publications Research Service, Washington, D.C.
VERTICAL MOTIONS IN STORM CLOUDS
N. Z. Pinus Sept. 6, 1963 7 p 5 refs Transl. into ENGLISH from Doklady Akad. Nauk SSSR (Moscow), v. 150, no. 4, June 1963 p 788-790
(JPRS-20956; OTS-63-31694) OTS: $0.50

An investigation of turbulence in thick cumulus and cumulonimbus clouds in 1959-1962 is presented. A diagram of the isolines of a cloud shows the formation of a "nucleus" on the axial part of the cloud. In this nucleus, the mean square velocity of vertical air motions exceeds 7 m/sec. Velocities drop off with increasing distance from the nucleus, and near the outer margin of the cloud they do not exceed 2 m/sec. At the stage of vigorous development of a cumulonimbus cloud (Cb calvus), the cloudless zone directly adjacent to the cloud is more turbulent than in the Cb incus zone. The coefficient of turbulent mixing averages 70 to 80 m^2/sec above the upper boundary of the cloud and when approaching directly to the leading edge of the anvil; upon entry into the cloud, its value increases to 100 m^2/sec on the upper boundary, but within the cloud, and in the zone of the nucleus with greater velocities of disorderly vertical motions of the air, they increase to an average of 300 to 400 m^2/sec. P.V.E.

N63-20948 National Aeronautical Lab., Bangalore (India)
SOME PRELIMINARY CONSIDERATIONS IN THE CHOICE OF RATED SPEEDS FOR WIND MACHINES
S. Janardhan Jan. 1963 20 p 2 refs
(NAL-TN-WP-20-63)

The wind characteristics at ten meteorological stations in India have been examined with a view to determining the optimum rated speed of a wind machine, of swept area 30 m^2 and overall power coefficient 12 percent, for economic extraction of energy. It is desirable to choose a rated speed between those corresponding to maximum energy output and minimum cost of energy. These two limits have been determined for the stations selected, and the average of these is recommended as the most suitable rated speed. Author

N63-20949 National Aeronautical Lab., Bangalore (India)
A STUDY OF THE HOURLY WIND SPEEDS AT BOMBAY (SANTA CRUZ) FROM THE POINT OF VIEW OF WIND POWER UTILISATION

R. Ramanathan and K. N. Narasimhaswamy Dec. 1962 25 p 2 refs
(NAL-TN-WP-19-62)

The data of hourly mean wind speeds have been analyzed from the point of view of wind-power utilization. The frequencies of different wind speeds have been determined and used for the estimation of the energy extractable from wind and the quantity of water pumped. The spells of low wind and diurnal variation of wind speed have also been examined. The annual mean wind speed is 12 km/hr. The energy output of a generator of cut-in speed 8 km/hr, swept area 30 m^2 and overall power coefficient 12 percent, works out to about 1,920 kwh/yr. The quantity of water that can be pumped annually by a windmill of the WP-2 type works out to 56,500 kl. A comparison of the wind power potentialities of this station with that of Bombay (Colaba) indicates that the potential output at Santa Cruz is higher due to better exposure to wind, which constitutes an important criterion in choosing between sites. Author

N63-21208 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
METEOROLOGICAL DATA REPORT – AEROBEE KP 3.2
Marjorie Mc Lardie Hoidale Aug. 1963 44 p 2 refs
(ERDA-61)

Meteorological data gathered for the launching of Aerobee KP 3.2 are presented. The data appear along with calculated ballistic data. Author

N63-21212 Federal Aviation Agency, Washington, D.C.
COMMON AVIATION WEATHER SYSTEM DETAILED DESIGN Summary Report
[1962] 45 p

This summary identifies the principal features of the Common Aviation Weather System (CAWS) operations, major equipment items, and an orderly sequence of steps for realizing the system. Services of the CAWS system are: (1) operational weather information appropriately presented at a great number of preflight briefing facilities, (2) in-flight weather assistance stemming from the weather system's operations-oriented information, (3) continuous and scheduled weather broadcasts, and (4) operational advice on an as-needed basis from a nationwide pilot-to-forecaster network. P.V.E.

N63-21274 National Aeronautics and Space Administration, Washington, D.C.
TIROS PROGRAM RESULTS
Morris Tepper Repr. from Astronautics, May 1961 p 61–68

The Tiros satellite program results are discussed and the following conclusions are reached concerning the weather satellites: (1) A satellite system can be developed around TV cameras and IR radiation detectors which will transmit with satisfactory fidelity the measurements of these sensors to the earth. (2) Such satellite measurements would contain useful meteorological information. (3) The meteorological information contained in the satellite data could be extracted and transmitted to the weather services in time to be of value in analysis and forecasting. P.V.E.

N63-21275 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA STORAGE FOR METEOROLOGICAL SATELLITES
M. I. Schneebaum and R. A. Stampfl Repr. from Aeron. and Aerospace Eng., Apr. 1963 p 48–51
(NASA RP-30)

Research in the field of electronic and magnetic data storage of video information in meteorological satellites is reported. Two unique TV systems based on electrostatic storage are being developed for Nimbus; both are characterized by conversion of an optical image to an electrical charge pattern that can be stored for relatively long periods of time (writing process), and by the transformation at will of this charge pattern into a video signal (reading process). The design and operation of these systems, which are being developed for advanced weather satellites, is discussed in detail. The present Tiros and initial Nimbus satellites contain conventional vidicons with magnetic tape as the storage medium. For this reason, and because the development of other types of large memories with size, weight, and power comparable to magnetic tape does not appear feasible within the next few years, improvements in magnetic tape storage devices are also discussed. M.P.G.

22 NAVIGATION AND GUIDANCE

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

N63-20758 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE-SIMULATED TESTING OF MARINER SPACECRAFT AUTOPILOT SYSTEMS WITH ROCKET MOTOR FIRING
John F. South N.Y., Am. Inst. of Aeron. and Astronautics [1963] 10 p Presented at the AIAA Guidance and Control Conf., Cambridge, Mass., Aug. 12–14, 1963
(NASA Contract NAS7-100)
(AIAA Paper 63-343) AIAA: $0.50 members, $1.00 nonmembers

Important to the success of the midcourse maneuver of the Mariner II Venus flight was the autopilot system, whose function it was to maintain an accurate and stable spacecraft attitude during the motor firing. It is now possible to test spacecraft autopilot systems with actual rocket-motor firings in a simulated space environment. This paper describes a series of rocket-motor firings in such an environment. Correlation of the results with preflight analysis and analog-computer simulation, and with the actual system performance of the Mariner-Venus spacecraft is also discussed. Author

N63-21019 Hawaii Inst. of Geophysics, Honolulu Meteorology Div.
RESEARCH ON THE METEOROLOGY OF THE TROPICAL PACIFIC AND ITS APPLICATIONS Final Report [Mar. 15, 1960–Mar. 31, 1963]
Ronald L. Lavoie June 1963 48 p 22 refs
(Contract AF 19(604)-7229)
(Hawaii Inst. Geophys.-37; AFCRL-63-803)

The research was directed toward the development of typhoon and terminal forecasting methods for the tropics. The research ranged over basic as well as operational problems dealing with the tropical Pacific. Among the topics considered were: (1) the problem of defining and predicting typhoon formation; (2) development of regression equations to predict typhoon movement and intensity changes; (3) upper-level wind forecasting by statistical techniques; (4) the climatology of the field of motion in the troposphere, and of the field of temperature in the stratosphere over the tropical Pacific; (5) evaluation of the island influence of an atoll; (6) the description and explanation of diurnal variations of low clouds and showers

over the sea; and (7) the information to be gained by a climatological treatment of wind–weather relationships in the Central Pacific. Author

N63-21081 Norwegian Defence Research Establishment, Kjeller
TECHNICAL DESCRIPTION OF THE RESEARCH DONE AT ANDØYA [TEKNISK BESKRIVELSE AV FORSØKSOPPLEGGET PA ANDØYA]
Birger Bjelland *In* Roy. Norweg. Council for Sci. and Ind. Res., Blindern Danish-Norweg. Rocket Res. [1963] p 23–28 In NORWEGIAN; ENGLISH Summary (See N63-21076 21-01)

The technical layout of the Danish–Norwegian rocket experiments performed at Andøya is presented. The principles of the phase and absorption experiments are given, and a new design of a rocket tracking system is described. The layout of the ground transmitter system and recording equipment is outlined, as well as two different payload tests performed by means of a simulator and a helicopter, respectively. A method used to watch the ionosphere in order to select the most favorable conditions for a firing is described. Author

N63-21083 Norwegian Defence Research Establishment, Kjeller
TELEMETRY AND ROCKET EXPERIMENTS AT ANDØYA [TELEMETRERING VED RAKETTFORSØKENE PA ANDØYA]
Arne Ryen *In* Roy. Norweg. Council for Sci. and Ind. Res., Blindern Danish-Norweg. Rocket Res. [1963] p 37–41 2 refs In NORWEGIAN; ENGLISH Summary (See N63-21076 21-01)

An FM-FM telemetry system was used for the Danish–Norwegian rocket experiments at Andøya. This system is characterized by a frequency modulated carrier with a multiplex of frequency modulated subcarriers. After a brief description of the FM-FM system, the instrumentation for this particular experiment is given, with respect to both rocket and ground installations. Author

N63-21173 Geophysics Corp. of America, Bedford, Mass.
INVESTIGATION OF PHYSICAL PHENOMENA FOR THE NAVIGATION OF SPACE VEHICLES AND EARTH SATELLITES
Ali M. Naqvi Dec. 1962 27 p 19 refs
(Contract AF 33(616)-7413)
(GCA-TR-62-24-A; ASD-TDR-62-1005)

Available information concerning the moon, which is likely to be of interest to designers of navigational aids for lunar vehicles, is given. This includes data on phases, spectral distribution, size and figure, and the intensity of Lyman alpha reflected from the moon. Preliminary design and operation of an automatic sextant for use in interplanetary vehicles is discussed. The sextant is capable of measuring angles, usually not exceeding 5°, with a precision of 0.2 in. Various aspects of satellite navigation by terrestrial occultations of stars are discussed. A condition for occultation in terms of stellar coordinates and the orbital elements of the satellite is derived. An occultation equation relating the time of occultation to the orbital elements is derived. The expected frequency of occultations is discussed. A method of "virtual occultation" using extinction of starlight in the atmosphere is discussed. An error of approximately 1/2 km in the satellite position measurement is anticipated, due to unpredictable variations of atmospheric density. The interference due to the brightness of earth's atmosphere is discussed. Author

23 PHYSICS, GENERAL

Includes: acoustics; cryogenics; optics; and thermodynamics.
For astrophysics see: 05 Astronomy and Astrophysics.
For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N63-20692 Atomic Energy Research Establishment, Harwell (Gt. Brit.)
THE CONSTRUCTION AND CALIBRATION OF A VARIABLE TEMPERATURE GOUY MAGNETIC SUSCEPTIBILITY APPARATUS
R. Colton Jan. 1963 24 p 6 refs
(AERE-R-4186)

An apparatus has been constructed to measure magnetic susceptibilities by the Gouy method over a wide temperature range. The cryostat is controlled electrically, and required temperatures are attained by balancing the cooling effect of liquid nitrogen against the heating effect of a coil. The temperature range runs from 77° K to about 350° K; temperatures are measured with a calibrated thermocouple. A large electromagnet produces a field of greater than 6000 gauss, and the force on the sample in the field is measured by a conventional semimicrobalance. Details of the magnetic field and thermocouple calibrations are given. Author

N63-20712 California U., Berkeley Lawrence Radiation Lab.
STRANGE-PARTICLE PRODUCTION BY 1170-MeV/c π^- MESONS
Jared Arnold Anderson (Ph.D. Thesis) May 27, 1963 43 p 21 refs
(Contract W-7405-eng-48)
(UCRL-10838) OTS: $1.00

Production of $\Lambda + K^0$, $\Sigma^0 + K^0$, and $\Sigma^- + K^+$ by 1170-Mev/c π^- mesons has been studied in the Lawrence Radiation Laboratory 72-inch hydrogen bubble chamber. Cross sections, angular distributions, and polarizations are presented. The polarization of the Σ^0 is determined at four center-of-mass angles and found to be small everywhere. Based on published results for the reaction $\pi^+ + p \rightarrow \Sigma^+ + K^+$, a comparison of the polarizations of Σ^+, Σ^-, and Σ^0 is made from the charge-independence triangle. A conclusion is reached that the Σ^- polarization should be large, and that the Σ^- and Σ^+ polarizations should be opposite in sign. Author

N63-20721 New York U., N.Y. Courant Inst. of Math. Sci.
ON GENTLE PERTURBATIONS, II
P. A. Rejto July 1963 102 p 37 refs Presented at 601st Meeting of the Am. Mathematical Soc., N.Y., Apr. 1963
(Contract DA-ARO-(D)-31-125-G159)
(IMM-NYU-312; AROD-983:24)

This report is based on the observation that the gentleness condition defined with the aid of a Holder condition is "local," and that for perturbations of finite rank the Friedrichs' equation admits a "formal solution." This formal solution is interpreted as a densely defined, possibly unbounded, bilinear form. Generally, a solution which is gentle over some interval plays the same role in constructing the spectral transformation of the part of the operator over this interval, as a gentle solution did in constructing the spectral transformation of the entire operator. Author

N63-20738 Wayne State U., Detroit, Mich.
THEORETICAL INVESTIGATIONS ON THE LIGHT SCATTERING OF SPHERES. XIV. THE WAVE LENGTH EXPONENT OF DIFFERENTIAL SCATTERING SPECTRA FOR AN ANGLE OF OBSERVATION OF 90°

Hari L. Bhatnagar and Wilfried Heller Aug. 10, 1963 16 p 8 refs
(Contract NONR-3511(00))
(Tech. Rept. 7(53))

Exact equations are given for the wavelength exponent of experimental differential-scattering spectra, $(n_{90})_o$, observed at an angle of 90° with respect to an incident unpolarized beam. Numerical values of the theoretical exponent, n_{90}, are derived from the Mie functions for α = 0.5 (0.1) 0.8 (0.2) 6.4 and m = 1.05 (0.05) 1.30. Values of the quantity $[\delta \ln(I_{90}/I_{oc})/\delta m]$ are also computed for α = 0.8 (0.4) 2.4 and the above m-values. Advantages and disadvantages of a practical application of $(n_{90})_o$ for particle-size determination are enumerated. Author

N63-20770 Rochester U., N.Y.
SU (3) SYMMETRY SCHEME, A REVIEW
Georges W. London May 21, 1963 29 p 10 refs
(Contract AT(30-1)-875)
(NYO-10274)

The paper briefly reviews the elements of group theory and goes on to apply this to the isospin group as an example. Rank-two groups in general, SU (3) in particular, are then discussed. The connection to physics is made through the identification of the basis vectors of the different representations with physical states. The mass formula, relating the masses within a multiplet, is derived to first order. Some dynamic predictions of the model are listed. The analogy, both formal and philosophical, to isospin and charge independence is emphasized. Author

N63-20777 Air Force Cambridge Research Labs., Bedford, Mass.
ON DETERMINATION OF THE OPTICAL ABSORPTION COEFFICIENT
Alfred Kahan and Herbert G. Lipson June 1963 67 p 10 refs
(AFCRL-63-325)

The equation for the optical absorption coefficient α in terms of the transmission and reflection coefficients T and R is derived. In addition, a computer program is described for the calculation of the absorption coefficient and optical constants, either from the combination of reflection and transmission coefficients, or from transmission experiments on two samples of different thicknesses. A set of tables of αd where d is the sample thickness, as a function of T in intervals of 0.2 percent for parameters of R in 0.5 percent is included. Both R and T values range between 0 percent and 100 percent. Author

N63-20780 Pittsburgh U., Pa. Atomic and Plasma Physics Lab.
AFTERGLOW ATOMIC COLLISION PROCESSES Technical Report No. 1
Manfred A. Biondi Aug. 20, 1963 35 p 25 refs
(Contract Nonr 624(06))
(APP-3)

Information is presented concerning atomic collisions involving electrons, ions, excited atoms, and normal atoms at near thermal energies; this has been obtained from studying the behavior of an ionized gas following the removal of external ionizing agents. Some of the atomic collision processes studied are elastic and low-energy inelastic collisions of electrons with molecules; electron ambipolar diffusion, electron attachment, electron ion combination; ion collision and charge transfer, ion conversion, and ion-ion recombination; metastable ionizing collisions, excitation transfer, and deexcitation and conversion. Quantities measured included electron density, temperature and collision frequency; density and concentrations of ions and metastable atoms or molecules; normal atom concentration, radiating atom or molecule concentration, and excited atom temperature. Methods used were microwave and radiofrequency techniques, probes, optical absorption, optical and mass spectrometry, and optical interferometry. C.L.W.

N63-20784 North Carolina U., Chapel Hill Inst. of Field Physics
CROSS SECTIONS OF YANG MILLS QUANTA
Edward A. Remler June 1963 12 p 13 refs
(Contract Nonr 855(07))
(*Its* Publ. 14; AFOSR 62-120)

Results are given of a calculation of the cross section of the two lowest order (in perturbation theory) processes in which real Yang Mills quanta take part when in interaction with a Dirac-type spinor field. A particular example of the general validity of the statement, that the sum of all diagrams, having no closed loops, in each order of perturbation theory is gage invariant, is given through the two expressions calculated here. The basic expressions and notations to be used are introduced, and the Yang Mills generalization of Compton scattering, along with the scattering of one Yang Mills quantum by another via a mechanism absent in the electrodynamic case, are discussed. C.L.W.

N63-20785 Rochester U., N.Y.
A CLASS OF LORENTZ INVARIANT HAMILTONIAN MODELS OF INTERACTING PARTICLES
R. Acharya July 9, 1963 14 p 7 refs
(Contract AT(30-1)-875)
(NYO-10276)

A class of Hamiltonian theories of interacting particles is constructed. The theories satisfy the principle of Lorentz invariance and lead to a nontrivial S-matrix. Author

N63-20786 Rochester U., N.Y.
ELECTROMAGNETIC PROPERTIES OF STABLE PARTICLES AND RESONANCES ACCORDING TO THE UNITARY SYMMETRY THEORY
A. J. Macfarlane and E. C. G. Sudarshan July 25, 1963 35 p 20 refs
(Contract AT(30-1)-875)
(NYO-10277)

It is shown that a theory whose SU_3-invariant strong interactions are perturbed by electromagnetic interactions alone may be obtained formally by a certain unitary transformation of a theory whose SU_3-invariant strong interactions are perturbed by merely charge-independent interactions. By exploiting readily available information on the latter theory, we can give a rapid derivation of relationships between the electromagnetic properties of various particles and resonances. While many new results are presented, principal emphasis is on the power of the method and on the recognition of the precise nature of the assumptions necessary for the derivation of results. Author

N63-20794 Minnesota U., Minneapolis Heat Transfer Lab.
RADIANT EMISSION CHARACTERISTICS OF DIFFUSE CONICAL CAVITIES
E. M. Sparrow and V. K. Jonsson Repr. from J. Soc. Am., v. 53, no. 7, July 1963 p 816-821 9 refs
(NASA Grant NsG-137-61)

The radiant interchange within a diffuse conical cavity has been formulated, without approximation for both cases of prescribed wall temperature and prescribed wall heat flux. Highly accurate numerical solutions have been obtained for a wide range of cone-opening angles and surface emissivities.

Results are presented for the radiant efflux from the cavity as a whole, and also for the distributions along the cavity surface of such quantities as the apparent radiant emittance, local heat flux (for prescribed surface temperature), and temperature (for prescribed heat flux). A comparison with the approximate analysis of Gouffe disclosed large errors in this prior work. Author

N63-20796 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SCHIFF'S CHARGES AND CURRENTS IN ROTATING MATTER

David L. Webster Repr. from Am. J. Phys., v. 31, no. 8, Part I, Aug. 1963 p 590-597 9 refs

Schiff's equations for fictitious charges and currents to be used with rotating axes of coordinates, written by him for fields in vacuum, are written here for fields in material media, and are illustrated with examples. Author

N63-20797 Grumman Aircraft Engineering Corp., Bethpage, N.Y.

A THEORETICAL APPROACH TO THE PREDICTION OF MOLECULE SURFACE INTERACTION

Richard A. Oman, Alexander Bogan, Calvin H. Weiser, and Chou H. Li N.Y., Am. Inst. of Aeron. and Astronautics [1963] 17 p Presented at AIAA Conf. on Phys. of Entry into Planetary Atmospheres, Mass. Inst. of Tech., Cambridge, Aug. 26-28, 1963

(NASA Contract NASr-104)

(AIAA Paper 63-463) AIAA: $0.50 members, $1.00 non-members

In order to increase the understanding of the interaction of gas particles with solid surfaces, some large-scale numerical computations of the classical trajectories of gas particles near a crystalline solid have been performed. Interpretations of the results of these trajectories and the corresponding responses of the lattice are given in terms of some of the dynamic similarity parameters which should control the interaction. The emphasis in this analysis is on conditions related to hypervelocity flight, where incident molecular energies are much higher than ordinary thermal energies, and collision times will approximate the natural vibrational periods of the lattice atoms. The theoretical model is set up with this specific situation in mind. Author

N63-20812 Boeing Co., Seattle, Wash.

DEFINITION OF TRANSIENT RADIATION SIMULATION ENVIRONMENT

A. R. Lowrey, R. K. Durkee, and C. Rosenberg [1962] 190 p 40 refs

(D2-9878-4)

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SECTION A. KUKLA GAMMA AND PULSE SHAPE DOSIMETRY A. R. Lowrey and R. K. Durkee p 1-68 10 refs (See N63-20813 21-23)

SECTION B. KUKLA NEUTRON FLUX AND SPECTRUM A. R. Lowrey, R. K. Durkee, and G. L. Keister p 1-99 28 refs (See N63-20814 21-23)

SECTION C. FLASH X-RAY DOSIMETRY C. Rosenberg and G. L. Keister p 1-19 2 refs (See N63-20815 21-23)

N63-20813 Boeing Co., Seattle, Wash.

KUKLA GAMMA AND PULSE SHAPE DOSIMETRY

A. R. Lowrey and R. K. Durkee *In its* Definition of Transient Radiation Simulation Environment [1962] p 1-68 10 refs (See N63-20812 21-23)

The gamma radiation environment of the Kukla prompt, critical assembly has been measured using chemical (tetrachloroethylene) dosimeters and a plastic scintillator-photodiode pulse shape monitor. The ratio of dose accumulated during the pulse to that accumulated from the beginning of the pulse to equipment recovery one hour later was measured, using glass rod dosimeters and an air-operated transfer tube. The gamma dose was found to vary as the inverse square of the distance from the reactor center, and to have the value $13.4\Delta T(\text{roentgen-Co}^{60})$ at 10 inches from the reactor center, where ΔT is the reactor temperature increase in degrees centigrade. The gamma dose at 10 inches was found to vary with temperature in the range $40° C \leq T \leq 115° C$ approximately as

$$\overline{D(10)}\,(r) = 12.1[\Delta T(°C) - 24.1(°C)],$$

while the approximate variation of the peak gamma dose rate at 10 inches is

$$D(10)\,\gamma(\text{peak})(r/\text{sec}) = 9.85 \times 10^4[\Delta T(°C) - 52.7(°C)].$$

The gamma dose rates were obtained by observing the pulse shape of the bursts with a plastic scintillator-photodiode monitor. Photographs of the monitor pulse were numerically integrated to obtain normalized rate data for various times during the pulse. The ratio of the dose absorbed during the reactor pulse to the total dose absorbed up to equipment recovery was found to be 0.656. P.V.E.

N63-20814 Boeing Co., Seattle, Wash.

KUKLA NEUTRON FLUX AND SPECTRUM

A. R. Lowrey, R. K. Durkee and G. L. Keister *In its* Definition of Transient Radiation Simulation Environment [1962] p 1-99 28 refs (See N63-20812 21-23)

Neutron flux measurements of the Kukla prompt, critical assembly have provided data defining the thermal and fast neutron environment and its variation with reactor temperature rise and distance from the reactor center. The thermal neutron flux measured with bare and cadmium-shielded gold foils varied slowly with distance from approximately $2.5 \times 10^8\Delta T(n/cm^2)$ at 20 cm to approximately $1.5 \times 10^8\Delta T(n/cm^2)$ at 150 cm from the reactor center, where ΔT is the increase in reactor temperature above ambient in (°C). The fast neutron flux monitored by exposing sulfur foils with the components and circuits being tested was found to follow an inverse squared variation with distance from the reactor center, with the value $4.5 \times 10^9\Delta T(n/cm^2)$ at 10 inches. The fraction of the total fast neutron flux measured by sulfur foils was found to decrease slowly with distance from the reactor center from the value 18.5% at 15 cm to 13.0% at 150 cm. The fast flux was found to be reasonably constant with variation of azimuthal angle in the horizontal plane. The mean energy was found to decrease slowly with distance from approximately 1.70 Mev at 20 cm to approximately 1.50 Mev at 150 cm. P.V.E.

N63-20815 Boeing Co., Seattle, Wash.

FLASH X-RAY DOSIMETRY

C. Rosenberg and G. L. Keister *In its* Definition of Transient Radiation Simulation Environment [1962] p 1-19 2 refs (See N63-20812 21-23)

Using a photodiode-plastic scintillator monitor and photographic film, the shape and homogeneity of flash X-ray pulses were determined. The pulse had a rise time of 25×10^{-9} seconds, a fall time of 90×10^{-9} seconds, and a width of 2×10^{-7} seconds. The X-ray beams were homogeneous in the regions near the axes of the beams. For some X-ray pulses double images were formed on the photographic

film indicating that for these pulses the X-ray tube appears as two non-coincident sources. The distance dependence of the intensity of the X-ray beam is essentially $1/R^2$. P.V.E.

N63-20827 Michigan U., Ann Arbor Electron Physics Lab.
INVESTIGATION OF LARGE-SIGNAL TRAVELING-WAVE TUBES Quarterly Progress Report No. 3
G. T. Konrad, J. E. Rowe et al Griffiss AFB, N.Y., Techniques Lab., Aug. 1963 98 p
(Contract AF 30(602)-2834)
(RADC-TDR-63-284)

A digital computer program is used to obtain solutions to a two-dimensional nonlinear analysis for large-signal traveling-wave devices and klystrons. Various values of axial magnetic field and space charge are used in the solutions. Theoretical work in the solution of large-signal phenomena in multistream microwave devices by a density function method is presented. Some of the results obtained in checking out the computer program are shown. Phase-shift data for a velocity tapered tube is compared with that for a conventional tube. Under certain conditions, the former is found to be more desirable from a standpoint of phase shift. Extensions and modifications to the digital-computer programs for electron guns are described. Relativistic effects and arbitrary axially symmetric magnetic fields can be taken into account. Some of the considerations in employing a Crestatron in a low-noise high-power amplifying chain are described. Several techniques are presented in keeping the noise figure low in a Crestatron. Data obtained when testing the magnetron injection gun in the beam analyzer are presented. Current density profiles obtained so far indicate that the beam is not entirely uniform. Author

N63-20832 General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
SODIUM COOLED REACTORS PROGRAM. FAST CERAMIC REACTOR DEVELOPMENT PROGRAM Sixth Quarterly Report, Jan.-Mar. 1963
F. J. Leitz, ed. Washington, AEC Div. of Tech. Inform., Apr. 1963 62 p 10 refs
(Contract AT(04-3)-189)
(GEAP-4214) OTS: $1.75

Progress reported in the fast ceramic reactor development program is as follows: (1) Three capsules containing mixed oxide fuel specimens have been fabricated for the second series of sodium logging tests. Microstructure examination of the fuel in the Series I logging specimens indicated localized Na-UO_2 reaction. UO_2, PuO_2, and mixed oxide fuel pellets crumbled on static exposure to sodium at 650° C for 20 hours, with the exception of the pellet consisting of 20 percent PuO_2-UO_2 with an O/M ratio of 1.97. (2) After a preliminary irradiation at 40 percent of the goal energy, the first capsule containing a 0.25-in.-diam. mixed oxide fuel specimen withstood transient irradiation which raised the peak fuel temperature to a calculated temperature of approximately 4900° F plus a small portion of the heat of fusion. (3) Preliminary capsule designs have been completed for (a) central fuel temperature measurement using gas thermometry and W-Re thermocouples, (b) high burnup irradiation tests of mixed oxide fuel with O/M stoichiometry of 1.97, 2.00, and 2.04, and (c) plutonium migration investigation using plutonium-242 tracer. (4) Calculation of the physics parameters for a 1000 fast ceramic reactor with a very low core H/D has been performed. P.V.E.

N63-20851 Chicago U., Ill. Laboratories for Applied Sciences
SYMPOSIUM ON MILITARY APPLICATIONS OF ULTRAVIOLET RADIATIONS WASHINGTON, D.C., JULY 14-15, 1960
P. E. Le Blanc and P. M. Tansey Nov. 1962 177 p 98 refs
(Contract NOw-63-0288-F)
(LAS-TR-199-37)

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N63-20854 Naval Research Lab., Washington, D.C.
REFLECTANCE OF MATERIALS IN THE VACUUM ULTRAVIOLET
W. R. Hunter *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14-15, 1960 p 47-57 6 refs (See N63-20851 21-23)

Highly efficient reflecting surfaces of dielectric on opaque aluminum, having about 80% reflectance, have been developed for use to wavelengths as short as 1000 Å. For wavelengths shorter than 1000 Å, the reflectance of the aluminum and dielectric combinations decreases and single layers such as platinum or rhodium are the best, reflecting about 20% at 584 Å. The reflectance of evaporated aluminum films stored in air decreases with age because of the formation of the oxide layer. Successful attempts have been made to prevent its formation by evaporating MgF_2 onto the aluminum surface within 20 seconds of the aluminum evaporation. Author

N63-20857 Baird-Atomic, Inc., Cambridge, Mass.
MEASUREMENTS ON METALLIC CATHODE SOLAR-BLIND PHOTOMULTIPLIERS
W. W. Striker *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14-15, 1960 p 87-93 (See N63-20851 21-23)

Measurements were made on photomultipliers to be used in a solar-blind receiver system in the region of 2500 Å. Solar-blind photomultipliers with metallic oxide cathodes have been tested using pulse-counting techniques. Relatively simple quantum efficiency measurements thought to be reliable within a factor of three are described. Author

N63-20859 Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
AN ULTRAVIOLET-SENSITIVE IMAGE TUBE
G. Skorinko, D. D. Doughty, and W. A. Feibelman *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14–15, 1960 p 101–109 8 refs (See N63-20851 21-23)

The design and performance of an image tube sensitive in the ultraviolet is described. The tube incorporates a standard vidicon-gun section and is operated in a standard vidicon-camera chain. The spectral response of the tube is determined by the choice of photocathode material and window. A tube having a CsI photocathode and a LiF window responds to radiation with wavelength between 1150 to 2000 Å. Other materials which would vary the response within the spectral region 1150 to 3000 Å are indicated. Resolution, sensitivity, time constant, and quantum yield measurements of a laboratory model of the tube are discussed. Author

N63-20860 Armour Research Foundation, Chicago, Ill.
SELECTIVE PHOTON COUNTERS FOR THE ULTRAVIOLET
H. L. Sowers *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14–15, 1960 p 111–128 11 refs (See N63-20851 21-23)

The principal effort has been directed toward the development of ultraviolet photon counters utilizing pure metal or semiconductor photocathodes, which give maximum response in the 0.2 to 0.3 Å region and high background rejection beyond 0.3 μ. This work also included fundamental studies of the properties of the photosurfaces and operating characteristics of the counters, and the fabrication of solar-blind photometers. Author

N63-20862 National Bureau of Standards, Washington, D.C.
THE PRESENT STATUS OF RADIOMETRIC CALIBRATIONS IN THE ULTRAVIOLET SPECTRUM
Ralph Stair *In* Chicago U., Ill. Labs. for Appl. Sci. Symp. on Military Applications of Ultraviolet Radiations, Wash., D.C., July 14–15, 1960 p 137–159 17 refs (See N63-20851 21-23)

At present two general types of radiometric calibrations in the ultraviolet are possible. The first type is the calibration for total radiant intensity of a source whether it be heterochromatic or monochromatic. Standards of total radiant intensity in the form of carbon filament lamps or of single line standards such as low-pressure mercury-arc lamps are available for these calibrations. The second type is the spectral calibration of detectors or spectroradiometers, and requires spectral sources such as the tungsten ribbon-filament lamps calibrated for spectral radiance by comparison with blackbodies. Author

N63-20880 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ACOUSTICS
Edward Kirchman *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 1962 56 p 21 refs (See N63-20876 21-33)

Noise sources in flight vehicles and methods of measuring and simulating them are discussed. The formulas for sound power level and sound pressure level are presented, and their relationships and manipulations are explained. A chart of man-made acoustic power extreme ranges and overall sound levels is included. The noise sources in flight vehicles considered include: propulsion system noise, aerodynamic boundary-layer noise, airborne equipment noise, propeller noise, and both far field and near field turbojet and rocket noise. The sonic fatigue and the environmental simulation types of acoustic testing are discussed, including a consideration of the newer techniques and equipment. Problems of simulating high-intensity sound and of correlating test results are considered. The plane wave tube appears to be the most flexible and accurate tool for generating very high sound pressure levels, although it is relatively expensive. M.P.G.

N63-20884 National Research Corp., Cambridge, Mass.
VACUUM TECHNOLOGY IN ENVIRONMENTAL SIMULATION
John C. Simons, Jr. *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 1962 25 p 44 refs (See N63-20876 21-33)

Vacuum technology requirements for high altitude and space environment simulation are reviewed. The characteristics of the total space environment are outlined. Since total simulation of the space environment is rarely attempted, the extent of vacuum required for simulation of thermal radiation, shortwave electromagnetic radiation, energetic particle bombardment, and surface phenomena (fatigue, bearing wear, cohesion, etc.) is indicated. The relationships of the total gas load and the volumetric speed of the pumping system in conventional high-vacuum systems are discussed, and techniques for vacuum pumping are classified according to the principles involved. Current ultrahigh vacuum techniques are reviewed, and pumping techniques for the 10^{-10} torr range are evaluated. Molecular drag pumps, ion-gettering pumps, pumping by surfaces cooled to liquid-nitrogen or liquid-hydrogen temperatures, and cryosorption are considered and their appropriate applications indicated, but the oil-diffusion pump, properly trapped to eliminate backstreaming oil vapor, is considered to be the most suitable general purpose pumping means. Achievement of still lower pressures (10^{-13} to 10^{-15} torr) will depend upon reducing the nonessential gas load, perhaps by using double-walled chambers, and reducing the backward flow common to all pumps. Measurements of low pressures and nonisotropic situations are also considered. M.P.G.

N63-20893 Argonne National Lab., Ill.
VARIANCE IN SCINTILLATOR LIGHT COLLECTION
George A. Sinnott and William W. Managan June 1963 9 p 1 ref
(Contract W-31-109-eng-38)
(ANL-6737)

A Monte-Carlo program for the "GEORGE" Computer at Argonne National Laboratory was used to compute the average path length and number of diffuse reflections of a light ray originating at a given point in a cylinder, before it is absorbed in a "black" concentric circle in the bottom of the cylinder. The variance of these numbers is estimated and indicates light-trapping effects. Total internal reflection at the exit (black) interface is included. The average number of reflections increases rapidly as the crystal length exceeds one diameter. Author

N63-20896 California U., Livermore Lawrence Radiation Lab.
TEST RESULTS FOR A 7-1/8-INCH I.D. X 12-INCH-LONG SODIUM CRYOGENIC COIL

C. E. Taylor and R. L. Nelson June 19, 1963 17 p 5 refs
(Contract W-7405-eng-48)
(UCRL-7401) OTS: $0.50

A 7 1/8-inch ID × 12-inch-long sodium cryogenic coil, having 77 turns of 0.605-in^2 conductor, was designed, fabricated, and tested to 21-kg central field. A sodium still was developed to produce the high purities required in the conductor. A refrigerator capable of testing this coil was designed and constructed. Test results show a total coil resistance of about 4×10^{-6} ohms at 21 kg with a current of about 10,000 amperes. This observed resistance is lower than the resistance expected, based on small sample measurements, by a factor of about 2. The test was prematurely terminated by a mechanical failure before the design was reached. Author

N63-20897 California U., Berkeley Lawrence Radiation Lab.
ELASTIC K^+-PROTON SCATTERING AT 910 MeV/c. POLARIZATION OF THE RECOIL PROTONS
Warner Hirsch (Ph.D. Thesis) May 1963 98 p 24 refs
(Contract W-7405-eng-48)
(UCRL-10813) OTS: $2.25

The Berkeley 30-in. propane bubble chamber was used to study the elastic K^+-proton interaction at 910 Mev/c in the region of transition, from the isotropy in angular distribution found below 810 Mev/c, to the rapidly increasing anistropy above 1 Bev/c. Results based on 1154 events show that the series $(1 + a \cos \theta_k^{cm})$ can fit the angular distribution with $a = 0.18 \pm 0.05$. Polarization was measured on the secondary proton by using proton-proton and proton-carbon recoils in the liquid of the chamber. The results of a phase-shift analysis incorporating polarization data are presented. Author

N63-20900 California U., Berkeley Lawrence Radiation Lab.
A GENERALIZED OPTICAL-POTENTIAL METHOD AND ITS APPLICATION TO THE SCATTERING OF ELECTRONS BY ATOMIC HYDROGEN
Robert Ta-Pang Pu June 18, 1963 79 p 33 refs
(Contract W-7405-eng-48)
(UCRL-10878) OTS: $1.75

The method is shown to combine the advantages of two conventional approaches, the eigenfunction expansion method and the optical-potential method, and to contain these two approaches as limiting cases. With certain modification to allow for the Pauli exclusion principle explicitly, the method is applied to the elastic scattering of electrons by hydrogen atoms for energies below the excitation of the second quantum level (10.2 ev), with 1s, 2s, 2p hydrogen atomic states used in the close-coupling scheme. The resulting coupled set of integro-differential equations, with approximated generalized optical potentials, was integrated numerically on an IBM-7090 computer, yielding phase shifts in various total spin and total angular momentum states. Results from this calculation are compared with other theoretical predictions and available experimental data. Author

N63-20917 Sandia Corp., Albuquerque, N. Mex.
PROJECT PLOWSHARE: SEDAN LONG RANGE BLAST PROPAGATION, NEVADA TEST SITE, JULY 6, 1962 Final Report
Jack W. Reed and Hugh W. Church Aug. 30, 1963 12 refs
(PNE-202F) OTS: $0.75

Microbarograph records of airblast waves from the Sedan shot were made at eight stations in California and Nevada at ranges from 100 to 230 miles. A 1.2-ton high-explosive calibration shot was fired at Sedan-minus-2 minutes to establish propagation conditions for bursts in air. Comparison of recorded signals indicated that Sedan blast-wave amplitudes averaged 20 percent of amplitudes which would have been transmitted had the Sedan yield been free-air burst. Individual transmissivity values ranged from 5 to 35 percent. Variations around the average are probably caused by atmospheric turbulence. Sedan blast waves were ducted toward the west by atmospheric refraction in the ozonosphere, where strong summer easterlies were blowing at 100,000- to 200,000-foot altitudes. Rocket wind measurements were made at Tonopah Test Range. Rocket and rawinsonde data were used to calculate atmospheric blast propagations which are in fair agreement with microbarograph measurements. Author

N63-20919 Canadian Armament Research and Development Establishment, Valcartier
SPECTROGRAPHIC STUDIES OF THE RADIATION EMITTED BY HYPERSONIC PROJECTILES
A. Dmitrieff-Kokline (Computing Devices of Canada Ltd.) July 1963 86 p 14 refs
(ARPA Order 133)
(CARDE-TN-1564/63)

Some preliminary results are presented of spectrographic observations of the intensity distribution of radiation emanating from the environment of hypersonic projectiles. An account is given of the development of a spectrographic system suitable for operation under range conditions, where special difficulties are encountered due to the ultrashort duration and feeble intensity of the emitted radiation. This system, which comprises mostly standard equipment, gives closely reproducible results in firings under near-alike conditions. Author

N63-20922 Mound Lab., Miamisburg, Ohio
PROFILE MEASUREMENT OF THIN LAYERS OF ALPHA-EMITTING MATERIALS
R. G. Olt, T. E. Eyles and A. W. Wotring July 26, 1963 12 p 9 refs
(Contract AT(33-1)-GEN-53)
(MLM-1159) OTS: $0.50

Methods are introduced which measure profiles of thin layers of alpha-emitting materials up to 10 mg/cm^2 thick. Nondestructive measurements by alpha counting and phosphor-enhanced pinhole autoradiographs resolve layer thickness at points 0.02 cm apart; accuracy within five percent can be obtained for layers of alpha activity 0.01 to 10 curies cm^2. Author

N63-20926 Brookhaven National Lab., Upton, N.Y.
INTRODUCTORY LECTURES ON THE PROPERTIES, DETECTION, AND CHEMICAL EFFECTS OF HIGH ENERGY RADIATIONS
Donald J. Metz Sept. 1962 32 p 4 refs
(BNL-748-(T-274)) OTS: $0.75

The discussion of radiation effects on materials included the interaction of matter with alpha and beta particles, accelerated electrons, gamma rays, X-rays, and neutrons. The lecture on detection and measurement included radiation counters, units and definitions, and radiation-measurement apparatus and techniques. The lecture on chemical effects included general features and some specific details of radiation chemistry, and the radiation chemistry of aqueous solutions and organic compounds. C.L.W.

N63-20946 Avco-Everett Research Lab., Everett, Mass.
VARIATIONAL THEORY OF THREE-BODY ELECTRON ION RECOMBINATION RATES

J. C. Keck and B. Makin (Southampton U.) June 1963 9 p 8 refs
(Contracts AF 61(052)-250; AF 04(694)-33; DA-19-020-ORD-5476; Proj. Defender)
(Avco-Everett Res. Rept. 158; BSD-TDR-63-139)

The variational theory of reaction rates has been used to calculate the rate of three-body ionic recombination in the process

$$A^+ + e + e^k \cdot A + e.$$

It is found that the rate-limiting step is deactivation at an energy level 5/2 kt below the dissociation limit and that the corresponding three-body rate constant is

$$k = 1.2 \times 10^{-8}\ T^{-9/2}\ cm^6/sec$$

in close agreement with numerical results. Author

N63-20972 Kyoto U. (Japan) Research Inst. for Fundamental Physics
PHASE SHIFT ANALYSIS OF p-p SCATTERING AT 52 MEV AND SPIN-ORBIT FORCE
Norio Hoshizaki, Shoichiro Otsuki (Nagoya U.), Ryozo Tamagaki (Hokkaido U.), and Wataro Watari (Osaka City U.) July 1963 28 p 24 refs
(RIFP-29)

A phase-shift analysis of p-p scattering at 52 Mev of the differential cross section, C_{kp} at 90°, and of the polarization at 45° is performed in terms of six parameters. The partial waves with $L \geq 3$ are assumed to be correctly represented by the one-pion-exchange contribution with $g^2/4\pi = 14.4$. It is shown that the present solution, together with the other ones at the near energies mentioned, seems to indicate that the effect of the spin-orbit force is not so strong below 100 Mev as at 310 Mev. This fact is not firmly conclusive at present because of the rather large experimental error of C_{kp}, but some phenomenological properties of the spin-orbit force that would explain the present solution are discussed. P.V.E.

N63-21002 Oxford U. (Gt. Brit.) Clarendon Lab.
THEORIES OF MAGNETISM Second Quarterly Technical Progress Report, 1 Jan.-31 Mar. 1963
R. J. Elliott [1963] 3 p 1 ref
(Contract DA-91-591-EUC-2698)

The magnetic properties of thulium were investigated. Thulium shows an interesting magnetic order in which the only component of the magnetic moment is parallel to the hexagonal axis. This moment shows a wave-like variation, just below the Neel temperature, which repeats every seven atomic layers. At a lower temperature, a more complicated ordering is observed, which eventually has four layers of spins pointing one way and three the other, with the same repeating distance. This latter ordering is the subject of the present investigation. A theory of the wave phase, developed by Elliott, but which did not treat the transition to the other order, was extended using an extension of the Bragg-Williams approximation. Results indicated that the transition from wave to layer structure takes place continuously, without a specific heat anomaly. These mathematical results are in agreement with experimental results. Thus, it appears that the usual simple theories of magnetic order, using essentially a molecular field technique, may be applied to this more complicated situation. I.v.L.

N63-21014 Oak Ridge National Lab., Tenn.
OPTICAL EMISSION FROM ELECTRON IRRADIATED THIN GOLD FOILS
D. C. Hammer (M.S. Thesis-Vanderbilt U.), E. T. Arakawa, L. C. Emerson, and R. D. Birkhoff Sept. 10, 1963 69 p 18 refs
(Contract W-7405-eng-26)
(ORNL-3468)

The light produced in thin gold foils, 340 Å and 530 Å thick, by high-energy electron bombardment has been investigated in the wavelength region between 2500 Å and 5500 Å. The experimental results show that gold emits a continuous distribution of photons polarized parallel to the plane of incidence over the spectral region investigated. The spectrum is characterized by a fairly rapid decrease in photon intensity at the shorter wavelengths to a minimum at 4500 to 5000 Å, followed by a gradual rise to 5500 Å. The experimental results were compared with the generalized theory of transition radiation, and with the low-energy bremsstrahlung theory. Author

N63-21018 Atomic Energy Commission, Washington, D.C.
REACTOR SAFETY. A LITERATURE SEARCH
Richard J. Smith, comp. Mar. 1963 140 p 1910 refs
(TID-3525(Rev. 5)) OTS: $2.50

A total of 1906 references to unclassified reports and published literature is presented on reactor systems, materials, and operation, designed to provide maximum safety for the reactor, reactor personnel, and environs. Information is included concerning incidents and conditions of operation considered hazardous. Author, reactor, and report number indexes are provided. Author

N63-21021 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
PROCEEDINGS OF THE WORKING CONFERENCE ON SLOW NEUTRON PHYSICS (7-12 DECEMBER 1961)
L. B. Pikel'ner, E. I. Sharapov, V. V. Golikov, V. P. Alfimenkov, V. Yu. Taran, and Yu. M. Ostanevich [May 1963] 300 p refs Transl. into ENGLISH by JPRS of a publ. "Materialy Rabochego Soveshchaniya po Fizike Medlennykh Neitronov" Obiedin. Inst. Yadernykh Issled. Dubna, 1962 240 p
(AEC-TR-5734) OTS: $3.50

Topics discussed at the conference on slow neutron physics included: (1) Spectrometry of Neutrons; (2) Properties of Neutron Resonances. Capture Gamma-Rays; (3) Reflection of Neutrons. Polarized Neutrons. Capture Cross Section of Thermal Neutrons; (4) Multichannel Transient Analyzers and Allied Problems; (5) Scattering of Slow Neutrons and Its Utilization to Study Molecules, Solids, and Liquids; and (6) Neutron-Structural Investigations. P.V.E.

N63-21026 Joint Publications Research Service, Washington, D.C.
QUANTUM GENERATORS AND "DEATH RAYS"
P. T. Astashenkov Sept. 6, 1963 16 p Transl. into ENGLISH of an article from At. Radiotekhn., Moscow, 1962 p 77-89 (JPRS-20959; OTS-63-31696) OTS: $0.50

A discussion is presented on the creation of monochromatic light sources which make it possible to obtain beams of radiation which are as sharply directed as needles, and to generate temperature effects equal to 10^{10}° C. These particular characteristics are discussed in terms of developing methods and instruments for local and space communication systems, space navigation, location and range finders, and for producing death rays which are to be used in a defense system against missile attack. C.L.W.

N63-21029 General Dynamics/Fort Worth, Tex.
ULTRAHIGH PRESSURE AS A TOOL FOR MOLECULAR ENGINEERING
E. Leigh Secrest Mar. 11, 1963 29 p 17 refs
(Contract AF 33(657)-11214)
(ERR-FW-192)

A discussion is presented of the ways in which ultrahigh pressure is being used in materials science laboratories as a tool for molecular engineering. P.V.E.

N63-21032 Argonne National Lab., Ill. Reactor Engineering Div.
A 200-WATT CONDUCTION-COOLED REACTOR POWER SUPPLY FOR SPACE APPLICATION
Donald R. Mac Farlane Mar. 1963 46 p 10 refs
(Contract W-31-109-eng-38)
(ANL-6694)

The proposed reactor is a small, high-density fast-core of U^{233} surrounded by a beryllium reflector. This approach, generally speaking, gives a reactor that is more compact and of lighter weight than can be obtained with a moderated system having a softer neutron spectrum. In the reactor design, the path of heat flow is from the core to the inner reflector, and then to the thermoelements in close contact with the inner reflector. The reject heat flowing from the thermoelement cold junctions enters the outer portion of the reflector, which acts as the heat sink and conducts the reject heat to the large, circular, tapered fin radiator which is attached to the reflector. Survey physics calculations for various reactor systems fueled with U^{235}, U^{233}, and Pu^{239} are reported. Some limits imposed on the system design by the thermoelectric generator are discussed, and the problem of radiator design for the space environment is treated in some detail. Author

N63-21041 California U., Livermore. Lawrence Radiation Lab.
TRANSPORT COEFFICIENTS FOR THE SQUARE WELL POTENTIAL MODEL
S. G. Brush and J. D. Lawrence June 1, 1963 29 p 1 ref
(Contract W-7405-eng-48)
(UCRL-7376) OTS: $0.75

Cross section integrals (given by Holleran and Hulburt) have been recalculated in order to provide the exact low density limit for calculations of the viscosity and other transport properties of a system of hard spheres with square well attractive forces. The new values should be accurate to four significant figures, and are given for many more values of the parameters. Listed are the values that disagree with those of Holleran and Hulburt in the second significant figure. C.L.W.

N63-21052 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
SCATTERING RESONANCES ON A FAST-WAVE STRUCTURE
Robert C. M. Li and A. A. Oliner June 1963 57 p 7 refs
(Contract AF 19(604)-7499)
(PIBMRI-1156-63; AFCRL-63-151)

The fast-wave structure analyzed here in detail consists of a parallel-plate waveguide perturbed by a series of periodic, parallel slits in the top plate. In the range $a/\lambda < 1/2$, the plane-wave scattering problem is considered for both E- and H-mode polarizations, and the anomalies are found to manifest themselves as a rapid variation in the phase of the reflection coefficient. When a/λ 1/2, there are no higher order diffracted waves, and the magnitude of the reflection coefficient is therefore fixed at unity. The relative periodicity is next extended to the range $1/2 < a/\lambda < 1$, and the scattering problem considered for E-mode polarization. The periodicity is now such that both the reflected wave and the first higher-order diffracted wave propagate transversely. Under such circumstances, it is convenient to use a scattering description for the fields, and the anomalies may then be observed as rapid variations in both magnitude and phase of the scattering coefficients. Author

N63-21066 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
INVESTIGATION OF COMBINED EFFECTS OF RADIATION AND VACUUM AND OF RADIATION AND CRYOTEMPERATURES ON ENGINEERING MATERIALS. VOLUME I: RADIATION-VACUUM TESTS Annual Report, 9 Nov. 1961-8 Nov. 1962
E. E. Kerlin Jan. 5, 1963 322 p 21 refs
(NASA Contract NAS8-2450)
(NASA CR-50948; FZK-161-1) OTS: $19.75 ph, $9.86 mf

A series of tests was performed to measure the combined effects of nuclear radiation and vacuum on a group of nonmetallic materials that are considered for use in nuclear-powered space vehicles. This group consisted of materials classified as adhesives, seals, thermal insulations, electrical insulations, potting compounds, dielectric materials, lubricants, structural laminates, and thermal-control coatings. Typical tests performed on material specimens included lap-shear strength, ultimate tensile strength, ultimate elongation, stress-strain characteristics, compressive strength, weight loss, lubricity, color changes, and spectral reflectivity. Two vacuum systems having pumping speeds in excess of 3000 1/sec at 10^{-6} torr were designed and built for use in these irradiations. Special dynamic test equipment was built for testing materials in vacuum after irradiation. Measured properties of the materials as a function of integrated neutron flux and gamma dose are reported, and recommendations for use of the various materials in nuclear-powered spacecraft are made. Author

N63-21125 European Organization for Nuclear Research, Geneva (Switzerland)
INTERNATIONAL CONFERENCE ON SECTOR-FOCUSED CYCLOTRONS AND MESON FACTORIES, CERN, APRIL 23-26, 1963
F. T. Howard (Oak Ridge Natl. Lab.) and N. Vogt-Nilsen, eds. May 29, 1963 455 p refs
(CERN-63-19)

Topics discussed at the International Conference on Sector-Focused Cyclotrons and Meson Factories included: (1) operating characteristics of and experience with sector-focused cyclotrons, (2) extraction experiments, (3) physics of high-current machines, (4) physics problems connected with the design of high-current machines, (5) new studies in orbit theory of sector-focused cyclotrons, (6) new design features of sector-focused cyclotrons, and (7) meson factories. P.V.E.

N63-21159 Block Associates, Inc., Cambridge, Mass.
INFRARED HORIZON STUDIES Final Report
Karl M. Hergenrother, Merle J. Persky, and A. L. Lavery June 31, 1963 57 p 1 ref
(Contract AF 19(628)-1618)
(AFCRL-63-640)

The preparation and evaluation of an infrared, interferometer spectrometer, used in conjunction with a Newtonian telescope for the balloon-borne measurement of the earth's infrared horizon, is described. Auxiliary systems were built and tested in support of the spectrometer. Author

N63-21161 California U., Berkeley Lawrence Radiation Lab.
INTERNAL IONIZATION THAT FOLLOWS A REACTION BETWEEN COMPLEX NUCLEI
Neftali H. Steiger June 26, 1963 31 p 20 refs
(Contract W-7405-eng-48)
(UCRL-10888) OTS: $0.75

The internal-ionization effect that follows a heavy-ion-induced nuclear reaction has been studied experimentally by means of magnetic analysis of the product atoms. The effect was investigated for the reaction $Pr^{141}(O^{16}, 8n)$ Ho^{149}. Target thicknesses from 26.2 $\mu g/cm^2$ down to 9.7 $\mu g/cm^2$ were used. For target thicknesses lower than about 25 $\mu g/cm^2$, nonequilibrium ionic-charge spectra are obtained that tend toward lower probabilities for the charge states lower than the equilibrium mean charge, and tend toward higher probabilities for the charge states higher than the equilibrium mean charge. As a result, the mean ionic charge increases from 17.6 ± 0.5 for the equilibrium case to 19.4 ± 1.0 for a target thickness of 9.7 $\mu g/cm^2$. By extrapolation to target thickness zero, an ionic-charge spectrum is obtained which we consider illustrates the "instantaneous internal ionization" obtained from the interaction between two complex nuclei. The shape of the extrapolated charge spectrum can be explained as being mainly composed of the two processes responsible for the internal ionization: (a) the nonadiabatic part of the transition following a change in nuclear charge, (b) the development of vacancy cascades as a result of internal conversion. Based on experimental results, the part of the ionization which has been caused by process (a) was estimated to be somewhat less than 800 ev. Author

N63-21171 Boeing Scientific Research Labs., Seattle, Wash.
SOME NEW TECHNIQUES FOR SCATTERED LIGHT PHOTOELASTICITY
Y. F. Cheng Sept. 1962 19 p 6 refs
(DI-82-0202)

A new method for the precision measurement of fractional birefringence in photoelasticity is proposed. Some new techniques are presented for determining the directions of the secondary principal stresses referred to as the secondary principal axes and their difference in scattered-light photoelasticity. Experiments were made for cases where the secondary principal axes remain constant, good agreements were found. Author

N63-21177 European Organization for Nuclear Research, Geneva (Switzerland)
INTERACTIONS OF POSITIVE PIONS WITH PROTONS NEAR THRESHOLD FOR SINGLE PION PRODUCTION
V. E. Barnes (Cambridge U.), R. Carrara, M. Cresti (Padua U.), I. Derado, A. Minguzzi et al July 22, 1963 17 p 18 refs
(CERN 63-27)

The interaction with protons of positive pions in the 300 Mev kinetic energy region has been studied in a hydrogen bubble chamber. Three types of events were considered: elastic scattering, single pion production, and single photon production. In the elastic scattering, the phase shifts of the Fermi I solution are substantially compatible with previous results. Cross sections are determined for the inelastic processes and, although statistics are very low, the results are compared with calculations based on the peripheral and the isobaric models. Author

N63-21178 Radio Corp. of America, Princeton, N.J. RCA Labs.
RADIATION DAMAGE TO SILICON First Semiannual Report, July 1, 1961 to Jan. 1, 1962
J. A. Baicket, B. W. Faughnan, R. L. Novak, and J. J. Wysocki (David Sarnoff Research Center) Jan. 1, 1962 43 p 20 refs
(NASA Contract NAS5-457)
(NASA CR-51044) OTS: $4.60 ph, $1.49 mf

The report is divided into four main sections, dealing respectively with measurements of excess carrier lifetimes, majority-carrier concentrations and mobilities, electron spin resonance, and thermally stimulated conductivity. Lifetime measurements are described; the methods included pulse-injection, solar-cell spectral response, and pulsed Van-de-Graaff injection. Lifetime vs temperature data indicate a defect level in n-type silicon located 0.18 ev below the conduction band. Evidences of trapping are described, and results using material from commercial solar cells are discussed. Resistivity-mobility measurements in n-type silicon confirm the location of a defect level at the same position in the band gap, but the identity of the recombination and carrier-removal centers at this position is inconclusive. The last two parts of the program have been confined to development of techniques and equipment; both electron spin resonance and thermally stimulated conductivity require high instrumental resolution and sensitivity. Spin resonances associated with the previously known defects in n-type silicon have been seen and are described. Author

N63-21179 Naval Research Lab., Washington, D.C.
NRL QUARTERLY ON NUCLEAR SCIENCE AND TECHNOLOGY Progress Report, Oct.-Dec. 1962
E. J. Schremp, P. H. Moravek, D. W. Joseph, G. A. Burginyon, and J. W. Butler et al Jan. 1, 1963 45 p refs

The following topics in nuclear science and technology are discussed: (1) quaternion approach to elementary particle theory, (2) baryon doublets and neutrino doublets, (3) theorems for construction of explicit representations of unitary operators in quantum field theory, (4) observations of nuclear and cosmic radiation in the ocean, and (5) the half-lives of Cs^{137} and Co^{60}. P.V.E.

N63-21182 Los Alamos Scientific Lab., N. Mex.
RAC, A COMPUTER PROGRAM FOR REACTOR ACCIDENT CALCULATIONS
Curtis G. Chezem and William R. Stratton Aug. 20, 1963 74 p 8 refs
(Contract W-7405-ENG-36)
(LAMS-2920)

The RAC code describes in detail the behavior of a graphite–uranium loaded reactor core in space and time during a power excursion. For calculational purposes, the core is assumed homogeneous and divided into an arbitrary number of squat, adjacent cylinders with a fixed, relative, flux distribution assigned to each such region. Given an assumption on the imposed reactivity function (step or ramp), the code cyclically generates fission energy, temperature, and pressure in each region. A measure of the kinetic or explosive energy of the reactor transient is eventually obtained. The mathematical formulation, operation, and complete computer listings are included in this report. The program was coded in FORTRAN for an IBM 7090 with Monitor operation. Author

N63-21187 Joint Publications Research Service, Washington, D.C.
DIFFRACTION OF A PLANE HYDROACOUSTIC WAVE AT THE BOUNDARY OF TWO ELASTIC PLATES
D. P. Kouzov Sept. 9, 1963 12 p 7 refs Transl. into ENGLISH from Prikl. Matemat. i Mekh. Moscow, v. XXVII, no. 3, (May–June) 1963 p 541–546
(JPRS-20981; OTS-63-31707) OTS: $0.50

The diffraction of hydroacoustic waves at straight-line discontinuities in an elastic layer is discussed. The case of low frequencies of the incident disturbance (frequencies for which the wavelength in the material of the layer is much larger than the thickness of the layer) is examined. The introduction of such a restriction permits a transition from the contact problem for two media (liquid–elastic solid) to the boundary-value problem for one medium (fluid), the surface boundary conditions for which are determined on the basis of the vibration equation of an infinitely thin elastic plate. The general solution is given for a two-dimensional problem of diffraction of a plane hydroacoustic wave at the boundary of two elastic plates, with different elastic properties for different conditions of contact between the plates. C.L.W.

N63-21196 European Organization for Nuclear Research, Geneva (Switzerland)
INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS AND NUCLEAR STRUCTURE – PROCEEDINGS, CERN, FEBRUARY 25-MARCH 1, 1963
Torleif Erickson ed. July 1963 207 p 119 refs
(CERN-63-28)

Topics discussed at the 1963 international conference on high-energy physics and nuclear structure included: (1) complex nuclei and strange particles, (2) nuclear structure information from high-energy electron scattering, (3) interactions of pions with complex nuclei, (4) information on nuclear structure from nucleon and electron reactions, (5) reactions of high-energy nucleons, deuterons, and alpha particles with nuclei, (6) fragmentation induced by high-energy particles, (7) muons and nuclear structure, and (8) complex nuclei as tools in elementary particle physics. P.V.E.

N63-21205 Rochester U., N.Y.
A HAMILTONIAN MODEL OF LORENTZ INVARIANT PARTICLE INTERACTIONS
T. F. Jordan, A. J. Macfarlane and E. C. G. Sudarshan July 3, 1963 47 p 18 refs
(Contract AT(30-1)-875)
(NYO-10275)

A model is constructed of interaction in a quantum mechanical system of two spinless particles. The interaction is shown to produce nontrivial scattering. Lorentz symmetry of the model is established by the construction of generators of a unitary representation of the nonhomogeneous Lorentz group. The total momentum and angular momentum operators are the same as for a system of two free particles. This insures familiar transformation properties under space translations and space rotations. The Hamiltonian satisfies the asymptotic condition relative to the Hamiltonian for a system of free particles. The use of the asymptotic condition is shown to be Lorentz invariant. The scattering amplitude is a manifestly invariant function of the particle momentum variables, and can be made to have a variety of analyticity properties by a suitable choice of the arbitrary form factors which occur in the model. Author

N63-21209 Stanford U., Calif.
EXCITATION OF FIELD-ALIGNED SOUND WAVES BY ELECTRON STREAMS Scientific Report No. 1
O. Buneman Apr. 1963 17 p 13 refs
(Contract AF 19(628)-233)
(SEL-63-030; AFCRL-63-497)

Irregularities moving across the magnetic field in aurorae and electrojets are explained as sound waves excited by streaming electrons. A three-component gasdynamic analysis (neutrals, ions, electrons) predicts growth of waves propagating across the field with velocity $(8\ KT/3m_i)^{1/2}$ provided the streaming velocity reaches a certain threshold which is somewhat higher than this value. The waves will travel more slowly than $(8\ KT/3m_i)^{1/2}$ when the electrons are a good deal faster than the threshold, which would account for an observed velocity spread. Author

N63-21217 General Dynamics Corp., San Diego, Calif.
EFFECT OF PULSED GAMMA RADIATION ON INFRARED DETECTORS [Final Report, June 1, 1960–Jan. 31, 1962]
V. H. J. Van Lint Kirtland AFB, N. Mex., Air Force Special Weapons Center, June 1962 83 p 9 refs
(Contract AF 29(601)-2818)
(AFSWC-TDR-62-29)
(GA-2984; AFSWC-TDR-62-29)

The response of various infrared detectors to a pulse of nuclear radiation has been analyzed theoretically and experimentally. The detectors studied included photoconductive lead-sulfide, lead-selenide and gold-doped germanium detectors, as well as an indium-antimonide photovoltaic-junction detector. The lead-sulfide and lead-selenide detectors were operated at room temperature; the others were tested at liquid nitrogen temperature. On an absolute basis, the detector which was most sensitive to radiation was gold-doped germanium and the least sensitive was lead-selenide. Author

N63-21258 Oak Ridge National Lab., Tenn.
GAS COOLED REACTOR PROGRAM Semiannual Progress Report for Period Ending Mar. 31, 1963
W. D. Manly July 23, 1963 379 p refs
(Contract W-7405-eng-26)
(ORNL-3445) OTS: $4.50

Progress is reported in support of the experimental gas-cooled reactor and on advanced reactor design and development. Included are: performance analyses, component development and testing, materials development, irradiation testing of components and materials, development of fueled-graphite bodies, investigations of fueled-graphite systems, clad fuel development, investigations of moderator materials, studies of advanced systems, experimental investigations of heat transfer and fluid flow, and facilities and equipment. C.L.W.

N63-21260 Alaska U., College Geophysical Institute
MAGNETIC, TELLURIC CURRENT, AND VLF OBSERVATIONS DURING THE 'FISH BOWL' TESTS OF 1962 Amended Special Report
Keith B. Mather and Eugene M. Wescott Jan. 1963 29 p
(Contract AF 19(604)-6180)
(UAG-R140; AFCRL-63-30)

The high-altitude nuclear tests conducted over Johnston Island were monitored at several stations with magnetic, telluric current, and 5 kc VLF equipment. The chief characteristic of the telluric current effects at all stations and with all tests is an initial rapid oscillation of period 2.5 to 3 seconds. A major disturbance was produced by the July 9 test, and in this case the first (small) disturbance arrived within 1 second after the detonation, followed immediately by the rapid oscillations, and oscillations of longer periods. Author

N63-21286 Columbia U., New York, N.Y.
EFFECT OF AN ELASTIC PLATE ON THE ACOUSTIC FIELD OF A POINT SOURCE
J. Lubliner July 1963 22 p 3 refs
(Contract Nonr-266(86))
(Tech. Rept. 32; CU-2-63 ONR-266(86)-CE)

A formal solution is obtained to the problem of the sound field due to a point source in a half-space bounded by an elastic plate. Asymptotic expressions are derived for the far-field

and surface-wave solutions, representing reflection and conduction, respectively. The conduction solution is used to draw some qualitative conclusions concerning self-noise on ships. Author

N63-21304 Armour Research Foundation, Chicago, Ill.
PERTURBATION SOLUTIONS FOR NONLINEAR PLANE WAVE EQUATIONS OF ACOUSTICS [Final Report, Dec. 1960-Mar. 1963]
William C. Sperry Wright-Patterson AFB, Ohio, Biophysics Lab., June 1963 44 p 3 refs
(Contract AF 33(616)-7746)
(AMRL-TDR-63-63) OTS: $1.25

General principles are established for the solution of a reasonably general set of nonlinear, partial, differential equations describing large amplitude propagation of plane waves through an ideal gas having constant coefficients of viscosity, heat conduction, and heat radiation. A perturbation technique is used which permits the set of nonlinear equations, for which there are no known closed-form solutions, to degenerate into an infinite number of sets of linear equations for which closed-form solutions can be obtained. Author

N63-21306 Carnegie Inst. of Tech., Pittsburgh, Pa.
THE EFFECT OF QUADRUPOLE VIBRATIONS ON *l*-FORBIDDEN M1 TRANSITIONS Technical Report No. 12
Raymond A. Sorensen July 19, 1963 13 p 9 refs
(Contract Nonr 760(15))

The effect of quadrupole vibrations on *l*-forbidden M1 transitions is computed using the wave functions resulting from the shell model with a residual pairing plus $P^{(2)}$ force. These wave functions for low states of an odd nucleus are a linear combination of a spin j quasi-particle and spin j' quasi-particles coupled to 2+ phonons to angular momentum j. The one-phonon components of the wave functions allow *l*-forbidden M1 transitions to proceed both via the single particle and collective M1 operators. The calculation shows that this quadrupole coupling can explain most of the observed transition rate in a number of cases, while in a few cases, particularly for the odd-N nuclei, fast transitions occur which are still unexplained. Author

N63-21326 Aerospace Information Div., Library of Congress, Washington, D.C.
SOVIET RESEARCH REACTOR RFT Summary of Data
Aug. 2, 1963 18 p 5 refs
(AID-P-63-103) OTS: $1.60 ph, $0.80 mf

This report on the Soviet RFT research reactor covers the following: general construction; core and reflector; core characteristics; fuel elements and fuel assemblies; reactor cooling; reactor control; experimental facilities; and experiments conducted in the RFT. J.R.C.

N63-21333 Armour Research Foundation, Chicago, Ill.
SOLUTIONS FOR NONLINEAR PLANE WAVE EQUATIONS OF ACOUSTICS BY THE METHOD OF FUNCTIONAL INTERRELATIONSHIPS OF DEPENDENT VARIABLES [Final Report, June-Oct. 1962]
Verner J. Raelson Wright-Patterson AFB, Ohio, Biophys. Lab., June 1963 30 p 4 refs
(Contract AF 33(616)-7746)
(AMRL-TDR-63-64) OTS: $1.00

A general formulation of the theory of propagation of finite amplitude waves in a nonlinear, viscous, heat-conducting, and heat-radiating medium is solved by the device of imposing one additional relationship upon the dependent variables. This approach is interpreted as an extension of the more usual one which ignores viscosity, heat conduction, and heat radiation, and which leads to commonly used formulations of nonlinear acoustics. Solutions are offered for two different choices of the additional condition on the dependent variables. The first of these leads to a complete solution in finite form but does not reduce to the nonviscous formulation upon setting viscosity equal to zero. The second solution, which fulfills this latter condition, is presented in the form both of an infinite series representation and graphically. Author

N63-21335 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRON IMPACT 2s AND 2p EXCITATIONS OF ATOMIC HYDROGEN
Kazem Omidvar Washington, NASA, Apr. 1963 72 p 32 refs
(NASA TM X-50562; NASA X-640-63-54) OTS: $7.60 ph, $2.36 mf

A numerical calculation has been carried out to evaluate the 3 × 3 cross section matrix involved in the electron-impact excitation of the ground state of H atom to the 2s and the 2p levels. The method of solution is that of atomic eigenstate expansion. The five cross sections, 1s-2s, 1s-2p, 1s-1s, 2s-2s and 2p-2p, are tabulated. The agreement of the 1s-2s cross sections with the experimental results are satisfactory while the calculated 1s-2p cross sections are higher than the corresponding experimental values. The 2s-2s and the 2p-2p cross sections have large values, specially at the thresholds. A Ramsauer effect in the partial cross sections of the 2s-2s elastic scattering is observed. By comparison with the eigenstate expansion calculation it is found that the Born approximation, despite its simplicity, gives meaningful results for low and close to threshold energies of the bombarding electrons. The effect of the electron spin and the exchange potentials are also investigated. Author

N63-21349 Geophysics Corp. of America, Bedford, Mass.
SPECTRAL REFLECTIVITY OF THE EARTH'S ATMOSPHERE III: THE SCATTERING OF LIGHT BY ATOMIC SYSTEMS
A. Dalgarno Dec. 1962 43 p 9 refs
(Contract AF 33(657)-9199)
(GCA-TR-62-28-A)

The theory of the scattering of light by an atomic or molecular system shows that deviations from Rayleigh scattering must occur as the wavelength of the incident radiation decreases to that corresponding to the first resonance transition. An extrapolation procedure, based upon experimental refractive index data, is used to obtain scattering cross sections at wavelengths larger than the corresponding first resonance wavelengths for the inert gases and for molecular hydrogen, oxygen, and nitrogen. The deviations from Rayleigh scattering are very large at ultraviolet wavelengths. A method is suggested for the direct calculation of scattering cross sections which is a generalization of a method used to calculate the refractive index of atomic hydrogen. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics.

***For related information see:* 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.**

N63-20709 Princeton U., N.J. Guggenheim Labs.
ANALYTICAL-EXPERIMENTAL CORRELATION OF RADIATION LOSS FROM AN ARGON ARCJET Technical Report
Martin P. Sherman and Paul F. Jacobs July 1963 42 p 18 refs
(Contract AF 33(657)-9962)
(Aeronautical Eng. Rept.-658)

An investigation to obtain an analytical estimation of the radiation loss from a partly-ionized, collision-dominated argon arcjet is described. The radiated power per unit volume was assumed to obey the relation $P = A(T/T_{ref})^n$, where T is the centerline temperature of the arcjet on the axis. The total measured radiation loss from the arcjet was 1.80 kw. Since the net power delivered to the gas was approximately 15 kw, the total radiation loss (at 12,600° K peak argon temperature) represented 12% of the jet power. P.V.E.

N63-20728 Aix-Marseille U. (France) Institut de Mecanique des Fluides
FUNDAMENTAL RESEARCH ON PLASMAS IN A MAGNETODYNAMIC SHOCK TUBE Final Report [RECHERCHES FONDAMENTALES SUR LES PLASMAS DANS UN TUBE A CHOC MAGNETODYNAMIQUE]
J. Valensi [1962] 89 p 26 refs In FRENCH
(Contract D.R.M.E. 16/62)

The high-temperature, high-speed performance of a magnetohydrodynamic shock tube was determined and the conductivity of the plasma produced was measured. A truncated conic shock tube was used in which the plasma obtained by an electric discharge in a low-pressure gas was accelerated electromagnetically. In the first study, the rapidity of the luminous front was related to the nature of the gas, the charge voltage, and the initial pressure. A second study consisted of a spectrographic analysis of the emission produced by the plasma, leading to the determination of the temperature, speed, and ionization density of the plasma. The values obtained for the speed of the luminous front are in perfect agreement for both studies. A table of the spectra obtained for plasmas of air and hydrogen is included. M.P.G.

N63-20755 General Electric Co., Schenectady, N.Y. Research Lab.
NONEQUILIBRIUM IONIZATION IN MAGNETOHYDRODYNAMIC GENERATORS
D. J. Ben Daniel and S. Tamor Jan. 1962 31 p 14 refs
(Rept. 62-RL-(2922 E))

The steady state ionization of a gas in which the electrons are hot and the atoms cool is investigated. The rate equations governing ionization, excitation, recombination, and de-excitation are solved for a model system using rate coefficients appropriate to the cesium atom. Included are all processes involving free electrons, as well as spontaneous emission and resonance trapping of radiation. No incoming radiation is assumed, and the system is assumed large compared to a collisional mean free path, but optically thin except for resonance radiation. The fractional ionization is computed for a range of electron temperatures and cesium densities of interest in MHD studies. It is found that there are reasonable conditions of temperature and density under which the ionization is close to that which would prevail if the system were in equilibrium at the electron temperature. At lower temperatures or densities, the ionization decreases but is still much greater than that appropriate to the gas temperature. Author

N63-20764 University of Southern Calif., Los Angeles, Calif. School of Engineering
STUDY OF PLASMAS IN HYPERSONIC FLOW Technical Report
David Robinson and James C. Williams III July 1963 60 p 14 refs
(Contract DA-04-495-ORD-3047)
(USCEC-81-101; EE-26; AROD-2790-1)

A Mach-6 low-density nozzle has been designed and constructed for studies of the decay of a nitrogen plasma after excitation by a radiofrequency discharge. Aerodynamic measurements have been made of the Mach number and density distribution for both cold flow and hot flow conditions. A method of measuring the heavy-particle temperature in a plasma is described using the rotational structure of the N_2 Second Positive Band System. Author

N63-20768 General Electric Co., Philadelphia, Pa.
STRUCTURES RESPONSE TO INTENSE ELECTROMAGNETIC RADIATION Technical Status Report No. 9, 1 Mar. to 31 May 1963
R. C. Good, Jr. [1963] 9 p 1 ref
(Contract AF 49(638)-1030)

Structure response to intense electromagnetic radiation is being studied by exploding in air a tungsten wire to produce a plasma and start hydrodynamic motion. Work carried out in the report period included: (1) photographing the exploding wire at several times during the explosion to indicate the expansion of the plasma and the time of radiation, (2) studying the thermal-elastic equations from which the stresses were computed to show that the coupling terms are truly small for the samples used, and (3) measuring the absorption coefficients of cobalt and soda glass over a wide part of the spectrum. P.V.E

N63-20781 California U., Livermore Lawrence Radiation Lab.
COMMAND RESONANCE CHARGING SYSTEM FOR THE ASTRON ACCELERATOR
K. A. Saunders, and R. L. Sewell May 14, 1963 24 p 4 refs
(Contract W-7405-eng-48)
(UCRL-7363) OTS: $0.50

The Astron concept will utilize the effects of a monoenergetic layer of relativistic electrons to contain and heat a plasma. The 5-Mev, 200-ampere electron source is a magnetic-induction linear accelerator. The accelerator is a series of pulse transformers fed from 471 parallel, 36-megawatt, line-type modulators. The pulse-forming networks for the modulators are parallel, RG-218/U coaxial cables, with a length of 0.4 μsec. The pulse-forming networks are charged by four command resonance-charge, voltage-regulated power supplies. Each charging supply is capable of furnishing 35 kv ±0.2%, 60 PPS into a 3.3-μf load. The voltage is regulated over the range of 20 to 35 kv, independent of repetition rate, by a crowbar circuit. Methods for reducing the effects of transients are presented. Author

N63-20839 MHD Research, Inc., Newport Beach, Calif.
TRANSIENT MOTION OF SPACE-CHARGE IN A PULSE-IRRADIATED GAP
Anthony Demetriades Mar. 20, 1963 23 p 4 refs
(Contract AF 29(601)-5202)
(MHD-636)

Solutions for two space-charge problems involving the transient motion of space-charge in a pulse-irradiated gap are presented. In the first, a species of negatively charged particles of initially uniform number density n_0 between two electrodes advances against a stationary background of positive particles of uniform density n_0. A front appears moving from the cathode to the anode across which the negative particle density jumps from zero (behind the front) to its initial value

(in front of the front). When the nondimensional parameter S, which compares the initially induced to the externally applied field, is smaller than 2, the solution is useful to the point where all the moving particles are depleted from the gap. When $S > 2$, some of the negative particles are trapped in the gap and come to a stop when the induced field just balances the applied field. In the second problem, positive ions are the only charged species contained in the gap. Exact solutions are found for the conduction process, which is shown to occur in one or two phases corresponding to $S < 2$ and $S > 2$. P.V.E.

N63-20888 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

PRELIMINARY INVESTIGATION OF PARTICLE-SUBSTRATE BONDING OF PLASMA-SPRAYED MATERIALS

Salvatore J. Grisaffe and William A. Spitzig Washington, NASA, Sept. 1963 31 p 13 refs
(NASA TN D-1705) OTS: $0.75

An investigation was undertaken to evaluate the effects of two plasma-spray powders, tungsten and zirconia, and four substrate materials, glass, stainless steel, tungsten, and copper, on the particle-to-substrate bond. All substrates except glass were metallurgically polished; the glass had a sufficiently smooth surface so that mechanical interlocking would not contribute to the resultant bond. It was found that the thermal conductivity of the substrate greatly influences the particle-to-substrate bond, whereas, in general, the physical properties of the spray powder have only a slight influence on the bond. Author

N63-20891 National Aeronautics and Space Administration, Washington, D.C.

AN ANALYSIS OF A VORTEX TYPE MAGNETOHYDRODYNAMIC INDUCTION GENERATOR

L.L. Lengyel and Simon Ostrach (Case Inst. of Tech.) 136 p 24 refs
(NASA Grant NsG-198-62)
(NASA TN D-2006) OTS: $2.75

Consideration is given to the performance characteristics of an a.c. magnetohydrodynamic power generator. A rotating magnetic field is imposed on the vortex flow of an electrically conducting fluid, which is injected tangentially into an annulus formed by two nonconducting concentric cylinders and two nonconducting end plates. A perturbation technique is used to determine the two-dimensional velocity and three-dimensional electromagnetic field and current distributions. Finally, the generated power, the ohmic losses, the effective power, and the electrical efficiency of the converter system are calculated. Author

N63-20898 California U., Berkeley Lawrence Radiation Lab.

AN EXPERIMENTAL INVESTIGATION OF THE STATE OF A HIGHLY IONIZED DECAYING HYDROGEN PLASMA

William Samuel Cooper III (Ph.D. Thesis) June 17, 1963 120 p 77 refs
(Contract W-7405-eng-48)
(UCRL-10849) OTS: $2.50

The atomic processes governing the decay of an initially highly ionized, dense, recombining hydrogen plasma are discussed qualitatively. The dominant process is three-body recombination. The upper excited states of neutral hydrogen atoms in such a recombining plasma are essentially in equilibrium with the free electrons, and the lowest excited state for which this is true is estimated. The theory necessary for determination of the plasma properties (electron density and temperature) is derived from a spectroscopic analysis of the emitted radiation in the visible and ultraviolet regions of the spectrum. Experimental details are given of the formation of a highly ionized hydrogen plasma in a strong magnetic field by a hydromagnetic ionizing wave. The plasma typically has an electron density of about 3×10^{15} xm^{-3} and a temperature of about $10^{4\circ}$ K, and is observed to decay in several hundred μsec. Author

N63-20936 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

PERFORMANCE EVALUATION OF A MAGNETICALLY SPUN D-C ARC OPERATING IN NITROGEN

D. R. Boldman Repr. from AIAA J., v. 1, no. 4, Apr. 1963 p 802-805 6 refs Presented at the ARS Electric Propulsion Conf., Berkeley, Calif., Mar. 14–16, 1962

The results of an experimental investigation of a concentric cylinder-type electrode configuration incorporating a magnetic field indicated that the arc-potential difference in nitrogen was essentially independent of the pressure in the range 1 to 7 atm, except for a specific range of operating conditions in which a 26% increase in arc-potential difference was obtained. Highest efficiencies were achieved during the high-potential operating mode. The independent effect of the electromagnetic force on the arc is not conclusive; however, experiments in which the magnetic-field strength was varied over a moderate range indicated the importance of optimizing this effect from the standpoint of both chamber efficiency and arc stability. Photographs of the arc reveal some of the effects of varying the magnetic-field strength. The arc-chamber efficiency was influenced also by the flow-injection mode. An increase in efficiency was obtained when the flow opposed or was normal to the direction of the Lorentz force. Author

N63-20967 Microwave Associates, Inc., Burlington, Mass.

GAS DUPLEXER (PINCH EFFECTS) Final Progress Report

Charles S. Ward Mar. 12, 1963 44 p 1 ref
(Contract AF 30(602)-2401)
(RADC-TDR-63-210)

This report describes an investigation leading to the design of a high-power microwave duplexer utilizing magnetic fields to improve switching efficiency within the limit of a specified recovery time. The technique used is that of imposing a constant magnetic field across the discharge and perpendicular to the incident microwave electric field. This results in appreciable reductions in recovery time without any deterioration in discharge arc loss. A prototype duplexer utilizing this effect was constructed in S-band for a power level of 6-mw peak, 10-kw average. Author

N63-20988 Princeton U., N.J. Plasma Physics Lab.

SPECTROSCOPIC OBSERVATIONS ON A FULLY-IONIZED BARIUM PLASMA

E. Hinnov, J. G. Hirschberg, F. W. Hofmann and N. Rynn June 1963 10 p 7 refs
(Contract AT(30-1)-1238)
(MATT-206)

The feasibility of producing a steady-state, highly-ionized plasma which is susceptible to spectroscopic determinations of various plasma parameters in the wavelength range most suitable for accurate measurements was investigated. Spectroscopic observations of a fully-ionized barium plasma indicated that, at zero current, the electron and ion temperatures measured at the midplane of the plasma are equal to the temperature of the hot rhenium plates at the ends of the plasma column. As the current between the end plates increased, the measured ion density fell off while the electron and ion density temperature increased at approximately equal

rates. At a current of about 25 ma, the density leveled off, and the electron and ion temperatures began to diverge. The point where the density levels off corresponds to the onset of a major instability in the plasma, and in the region of instability there is evidence of considerable nonthermal particle motion. The results indicate that such a steady-state plasma is producible. P.V.E.

N63-21009 University of Southern Calif., Los Angeles
VACUUM ULTRAVIOLET RADIATION AS A PROBE OF RARE GAS PLASMAS Technical Report, Nov. 1961 to May 1962
H. E. Blackwell, G. S. Bajwa, G. S. Shipp, and G. L. Weissler
May 1, 1963 76 p 41 refs
(Grant DA-ORD-31-124-61-G47; Contract DA-04-495-ORD-1409)
(AROD 2262-7)

It has been shown that the plasma absorption of ultraviolet radiation of specific wavelengths can be expressed in terms of the number densities of absorbing particles. The experiment presented here illustrates this procedure of using shock-heated xenon gas to measure, as a function of time, number densities of Xe and Xe^+. Emphasis has been on the experimental results. This method can be applied to determine number densities of doubly, as well as singly, ionized and neutral plasma particles. In addition, this research can make use of these large ion concentrations in shock tubes to measure photoionization cross sections of a variety of ionic species for which no experimental data are available at the present. Author

N63-21054 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE EXPANSION OF A PLASMA COLUMN IN A LONGITUDINAL MAGNETIC FIELD
Ching-Sheng Wu June 30, 1961 27 p 3 refs
(NASA Contract NASw-6)
(NASA CR-51021; JPL-TR-32-126) OTS: $2.60 ph, $1.01 mf

The expansion of an infinitely long plasma column in a longitudinal magnetic field is considered. An initial equilibrium condition is postulated. The plasma is assumed to have finite conductivity. The analysis is based on the one-fluid hydrodynamic theory. Author

N63-21060 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
AN UNSTEADY PROBLEM IN MAGNETOHYDRODYNAMICS
Stephen Childress Repr. from Quart. Appl. Math., v. XXI, no. 1, Apr. 1963 p 76–78 1 ref
(NASA Contract NAS7-100)
(NASA CR-50960; JPL-TR 32-275)

A mathematical treatment is given for an infinite mass of incompressible, electrically conducting fluid which is penetrated by a uniform magnetic field H i and subject to disturbances. Magnetohydrodynamic equations are given which describe the phenomena occurring under these conditions. C.L.W.

N63-21158 Princeton U., N.J. Plasma Physics Lab.
HIGH FREQUENCY CONDUCTIVITY OF DEGENERATE SEMICONDUCTORS
Amiram Ron, and Narkis Tzoar (Bell Telephone Labs., Whippany) Apr. 1963 7 p 8 refs
(Contract AT(30-1)-1238)
(MATT-189)

The problem of high-frequency conductivity of a degenerate semiconductor is investigated by a kinetic description. The finite duration of encounters is taken into account in a self-consistent fashion which properly includes collective effects. This treatment is an extension for quantum plasmas of the Dawson–Oberman method given for classical plasmas. Author

N63-21188 Princeton U., N.J. Plasma Physics Lab.
INTERPRETATION OF OBSERVED IMPURITY RADIATION IN A DISCHARGE OF THE C-STELLARATOR
Einar Hinnov May 1963 35 p 13 refs
(Contract AT(30-1)-1238)
(MATT-194)

Measurements of absolute intensities of the resonance multiplets of oxygen ions in a typical discharge of the C-Stellarator are employed to deduce the ion concentrations as a function of time. The analysis of the data is based on an idealized model in which electron temperature and density are uniform both radially and axially. Electron temperatures are found from relative intensities of some of these multiplets, and compared with temperature computed from the electrical conductivity. Mean particle confinement times are deduced from the time behavior of the concentrations of highly ionized oxygen. From these confinement times, and the observed electron density changes, the particle influx rates are obtained. The total power loss by radiation is evaluated for the uniform model. The radiation by oxygen ions, which is explicitly nearly independent of temperature, and the ionization and heating of hydrogen influx, which is nearly proportional to temperature, are found to be the dominating mechanisms of power loss. Author

N63-21213 Princeton U., N.J. Plasma Physics Lab.
COMPOSITION PRODUCT SIMULATOR
Claude Breton and Joseph G. Hirschberg May 1963 20 p 2 refs
(Contract AT(30-1)-1238)
(MATT-199)

The composition product simulator is an optical device, giving the compositon product of two functions $S(\lambda)$, $I(\lambda_1 - \lambda)$,i.e., a source and an instrumental function. The resultant function $R(\lambda_1)$ is obtained with an accuracy better than ±2%. The composition product simulator makes it possible to draw the curves (useful in spectroscopic line-breadth measurements): $s/r = f(i/r)$ where s, i, and r are widths of the source function, the instrument function, and the resultant function, respectively. These curves give s, knowing i and r; by comparing the shape of the R function obtained using a given S function with the shape of the experimental R function, we can deduce the actual shape of the S function. Applications are given for a two-slit ideal system and for a practical case using a Fabry–Perot interferometer. Author

N63-21244 Pratt and Whitney Aircraft, East Hartford, Conn.
INVESTIGATION OF MAGNETOHYDRODYNAMIC POWER GENERATION. VOLUME V – THEORETICAL PLASMA CONDUCTIVITY STUDIES Final Report
S. J. Markowski Jan. 1963 200 p 44 refs
(Contract AF 30(602)-2487)
(PWA-2133; RADC-TDR-62-464, Vol. V)

The formulas for the electrical conductivity and diffusion coefficients of a magnetohydrodynamic generator plasma, including ion flow, are derived. The electron-energy equation is developed leading to an expression for electron temperature. These formulas are applied to calculating these quantities in segmented and unsegmented MHD generators. It is shown that in segmented generators these quantities have much more favorable values. The MHD-electrode boundary layer is investigated to find the electrode voltage drop. The electron

and ion continuity and current and energy equations across the boundary layer are formulated. Due to time limitations, simplified forms of these equations are solved simultaneously with the integral form of the gas continuity, momentum, and energy relationships. This leads to profiles of the electric field, electron density, and electron temperature. The electric field is integrated across the boundary layer to find the voltage drop per unit boundary-layer thickness. Author

N63-21245 Pratt and Whitney Aircraft, East Hartford, Conn.
INVESTIGATION OF MAGNETOHYDRODYNAMIC POWER GENERATION. VOLUME I – SYSTEM ANALYSIS AND ENVIRONMENTAL TESTING Final Report [Apr. 19, 1961-Dec. 31, 1962]
S. J. Markowski et al May 1963 331 p refs
(Contract AF 30(602)-2487)
(PWA-2170; RADC-TDR-62-464, Vol. I)

In the system analysis of 1000- and 250-megawatt generators, the necessary equations are derived, the assumptions discussed, loss mechanisms are considered, and design conditions determined and presented in parametric form. An environmental testing program which investigated the areas of bulk and boundary-layer conductivity, structural concepts, and combustion phenomena is also presented. Author

N63-21267 Cornell U., Ithaca, N.Y.
THE HYDROMAGNETICS OF AN ELLIPSOID MOVING IN A CROSS-FIELD Technical Report No. 4
G. S. S. Ludford and M. P. Singh July 1963 21 p 7 refs
(Contract Nonr-401(46); NSF Grant G-19911)

The motion of an arbitrary ellipsoid through an incompressible inviscid, electrically conducting fluid in the presence of a transverse magnetic field is studied. The present treatment by means of linearized equations cannot be expected to provide more than an indication of the ultimate flow pattern. The fact that the three-dimensional results tend to reliable two-dimensional ones as $b \to \infty$, leads to the conclusion that they are qualitatively correct. A nonconducting ellipsoid will allow the fluid to pass through its cylinder to some extent, but will also force the fluid to go around it. A conducting ellipsoid will behave like a very tall nonconducting one, hence will force all the fluid to go around it. J.R.C.

N63-21268 Cornell U., Ithaca, N.Y.
THE HYDROMAGNETICS OF A SPHERICAL CONDUCTOR Technical Report No. 5
G. S. S. Ludford and M. P. Singh July 1963 6 p 3 refs
(Contract Nonr-401(46); NSF Grant G-19911)

A study is made of the hydromagnetics of a spherical conductor, and it is shown that a sphere of arbitrary nonzero conductivity in a moving magnetic field is accompanied by the magnetic field. The leading term in the decay of the magnetic disturbance is obtained, which is not the same as for a perfect conductor. The derivation of the ultimate flow pattern for motion along the magnetic field does not involve the conductivity of the sphere. The problem of determining the potential parts outside the sphere and the potential field inside the sphere is the same as for an insulator; the total magnetic field must be continuous across the surface of the sphere. J.R.C.

N63-21287 Pratt and Whitney Aircraft, East Hartford, Conn.
INVESTIGATION OF MAGNETOHYDRODYNAMIC POWER GENERATION. VOLUME I – SYSTEM ANALYSIS AND ENVIRONMENTAL TESTING
May 1963 264 p
(Contract AF 30(602)-2487)
(RADC-TDR-62-464, Vol. I, PWA-2170)

This document is an appendix containing the figures to go with the final report on the investigation of magnetohydrodynamic power generation; Volume I—System Analysis and Environmental Testing. P.V.E.

N63-21288 Pratt and Whitney Aircraft, East Hartford, Conn.
INVESTIGATION OF MAGNETOHYDRODYNAMIC POWER GENERATION. VOLUME VI – PRELIMINARY DESIGN OF 1000 AND 250 MEGAWATT MHD GENERATORS Final Report
Frank J. Mollura et al Feb. 1963 133 p 2 refs
(Contract AF 30(602)-2487)
(RADC-TDR-62-464, Vol. VI; PWA-2164)

This report presents the results of preliminary engineering designs of 1000 and 250 megawatt MHD dc power generators which are compatible with continuous-wave radiofrequency conversion systems. The investigation consists of a systematic survey, analysis, and evaluation of the problems involved. Combustion, aerodynamic, thermodynamic, electrical and magnetic, thermal, chemical, and mechanical effects acting independently or, more generally, in combination, were studied and evaluated. Suitable methods and techniques were used or conceived to handle the problems. The results of the investigation are presented in the form of preliminary design layouts, diagrams, drawings, graphs, and tables. Author

N63-21314 General Electric Co., Philadelphia, Pa. Missile and Space Div.
THEORETICAL PERFORMANCE OF MHD GENERATORS WITH VARIOUS ELECTRODE GEOMETRIES
G. W. Sutton Aug. 1963 44 p 4 refs
(Contract AF 49(638)-914)
(R63SD62)

The performance of various electrode geometries has been analyzed for MHD generators, assuming scalar electrical conductivity and steady, inviscid incompressible flow, with the following results: (1) for electrodes whose height is less than the channel height, the electrode current is reduced, but the open circuit voltage and efficiency are unchanged, as compared to the ideal case; (2) "wrapped around" electrodes cause internal shorting with a resulting decrease in voltage and efficiency; (3) finned electrodes cause less internal shorting and loss of efficiency than "wrapped around" electrodes, and may be of importance in reducing the apparent impedance of segmented electrodes for the case of tensor conductivity. Author

25 PHYSICS, SOLID-STATE

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N63-20702 College of Aeronautics, Cranfield (Gt. Brit.)
THE EFFECT OF NITROGEN IN α-IRON ON FERROMAGNETIC DOMAIN BOUNDARY MOVEMENT EXAMINED BY A MECHANICAL DAMPING METHOD
M. J. Steward May 1963 21 p 10 refs
(CoA-153)

The effect of aging below 200° C on the hysteresis loss in α-iron containing nitrogen has been investigated. The extent to which nitrogen is removed from solid solution during aging, and the domain boundary hindrance developed, was assessed by mechanical damping, using a low-frequency inverted torsional pendulum. Nitrogen, both in solution and as the precipitated form Fe_8N, was found to increase the resistance to domain boundary movement, the precipitated form being the more effective in this respect. Most of the damping changes due to aging are developed in less than 2 hours at 150° C. Author

N63-20707 California U., Berkeley Lawrence Radiation Lab.
DISLOCATION SUBSTRUCTURE IN QUENCHED ALUMINUM SINGLE CRYSTALS
Jean-Loup Bernard Strudel (M.S. Thesis) June 1963 45 p 31 refs
(Contract W-7405-eng-48)
(UCRL-10793) OTS: $1.00

Observations have been made by transmission electron microscopy of thin foils of high-purity aluminum single crystals quenched from 651° C into water at 0° C. Loops of 250 Å diameter have been found lying on (111) planes. Electron-diffraction contrast experiments using single crystals of [111] orientation have shown that the loops are 99% of the Frank sessile type. Single crystals of [110] orientation have been used to study interactions between glissile dislocations and Frank sessile loops. When a moving dislocation came close to a loop, the stacking fault was destroyed and the loop often became attached to the moving dislocation, causing it to glide prismatically to the surface of the foil. Author

N63-20708 Brown U., Providence, R.I.
DOUBLE-CANTILEVER CLEAVAGE MODE OF CRACK PROPAGATION
P. P. Gillis and J. J. Gilman July 1963 48 p 18 refs
(Grant DA-ARO(D)-31-124-G400)
(DA-G400; AROD-3887-1)

In determining specific surface energies of solids by the quantitative cleavage method, there are several possible sources of error. Some of these are investigated analytically and limits on specimen geometry are established for accurate results. Effects of nonlinear elastic behavior, plasticity, and axial forces are assessed; methods of avoiding these difficulties are suggested. Author

N63-20713 Ohio State U., Columbus
SIZE EFFECT IN POLYCRYSTALLINE INDIUM PLATES IN A MAGNETIC FIELD Technical Report 9
P. Cotti, J. L. Olsen (Swiss Federal Inst. of Tech., Zurich), J. G. Daunt, and M. Krietman Aug. 1963 10 p 10 refs
(Contract N6onr-495(20))

The magnetoresistive behavior of a polycrystalline indium plate in a magnetic field is discussed. It is shown that the resistivity first increases due to bulk magnetoresistance. It then drops for fields parallel to the plane of the specimen. The field at which this occurs is of the magnitude to be expected from theoretical considerations. The continued resistivity increase, when the field is perpendicular to the surface of the film, has been explained as a consequence of a contribution of the Hall effect to the resistivity of wide plates. P.V.E.

N63-20719 Tyco Labs., Inc., Waltham, Mass.
THE SURFACE BARRIER EFFECT IN PHOTOVOLTAIC CONVERSION Final Summary Report
Georg Rupprecht May 1963 22 p 4 refs
(Contract AF 19(604)-8506)
(AFCRL-63-815)

The photovoltaic effect has been investigated in cells constructed by the evaporation of a metal film on a semiconductor surface. The feasibility of this mode of preparation is demonstrated by the relatively high efficiencies which have been obtained. For high efficiency, the thickness of the oxide layer between the semiconductor and the metallic film must be below a critical thickness. The short circuit current of cells with oxide layers thicker than the critical thickness has an ohmic character; when the thickness of the oxide layer is less than the critical thickness, the current results from tunneling between the metal and semiconductor. The photovoltaic effect is determined by surface states of the semiconductor-oxide interface, rather than by the difference of the work functions of the semiconductor and the metallic electrode. Author

N63-20899 California U., Berkeley Lawrence Radiation Lab.
THE EFFECT OF ANGULAR MOMENTUM OF THE COMPOUND NUCLEUS ON THE RATIO OF THE ISOMERS Te^{119} AND Te^{119m} PRODUCED IN LOW-ENERGY BOMBARDMENTS
David W. Seegmiller (Ph.D. Thesis) Aug. 1963 209 p 96 refs
(Contract W-7405-eng-48)
(UCRL-10850) OTS: $3.00

Five different projectiles were used to produce the compound nucleus Te^{122*}, which yielded the isomers of tellurium-119 through a 3n reaction. The projectiles ranged in size from He^3 to O^{18}. The same isomers were also produced through 2n and 4n reactions by bombardment of the appropriate tin isotopes with He^3 and He^4. A method involving separation of the antimony daughter was devised for determining the isomer ratios. This method was completely independent of any decay scheme. The expected increase of ratio with energy and projectile size was verified. Excitation functions were obtained for the reactions proceeding through the Te^{122*} compound nucleus. The expected shift in peak position with projectile size was clearly demonstrated. Compound-nucleus calculations were performed by assuming a rounded nuclear potential approximated by a parabola (Bunthorne). Good agreement was obtained between experimentally determined isomer ratios and predictions based upon the calculated average angular momentum of the compound nucleus. Calculations of the Vandenbosch–Huizenga type were performed for the various reactions. Author

N63-20939 Institut für Allgemeine Metallkunde und Metallphysik, Technischen Hochschule, Aachen (W. Germany)
RECRYSTALLIZATION OF SINGLE CRYSTALS Final Technical Report
Kurt Lücke et al Aug. 1963 29 p 8 refs
(Contract DA-91-591-EUC-2438)

Grain boundary motion in silver bicrystals obtained by sintering of two single crystals and growth selection in strained single crystals after artificial nucleation were described. Quantitative description of the orientation scattering of the crystals obtained by growth selection was introduced; a theory of growth selection in single crystals on a statistical basis was developed; and the physical theory of grain boundary motion in the presence of impurity atoms was improved. C.L.W.

N63-20940 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Res. Labs.
PARAMAGNETIC RESONANCE ABSORPTION BY THE TITANIUM (+3) ION IN CORUNDUM Quarterly Scientific Report 3

Carl Pitha (AFCRL), J. G. Castle, Jr., D. W. Feldman, and David C. Brunham May 22, 1963 12 p 12 refs
(Contract AF 19(628)-1640)
(Rept. 63-928-110-R2; AFCRL-73-171)

The absorption spectrum of Ti(+3) ions has been observed in several crystals of Al_2O_3 at low temperatures and 9 gc/sec. The single resonance line observed as a function of magnetic field strength at a given angle is so asymetric that an unusual technique was necessary to plot out the line shape; the technique is described. The previous crystal field theory of D. K. Rei is corrected and applied to the 3d configuration of Ti(+3). The observed line shape is discussed in terms of variations in local strain at the Ti(+3) site. Author

N63-20941 Harshaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Div.
RESEARCH ON PHOTOVOLTAIC CELLS Fifth Quarterly Progress Report, [May 1, 1963–July 31, 1963]
Norman E. Heyerdahl, Roger F. Belt, Donald J. Harvey, and James C. Schaefer Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Aug. 1963 20 p 5 refs
(Contract AF 33(657)-7916)
(BPSNx-62(8-7116)-70715)

Progress was reported on the development of a cadmium-sulfide thin-film photovoltaic cell. Included were studies on film preparation, photovoltaic barrier studies (through attenuated total reflection and surface microtopography), and X-ray studies of the growth and perfection of single crystals. A study of new materials is combined with a study of the photovoltaic mechanisms involved in thin-film photovoltaic cells. Work was conducted on the preparation of cadmium-telluride, zinc-selenide, and gallium arsenide thin films of suitable purity, homogeneity, continuity, and conductivity. Gallium arsenide and cadmium telluride were prepared as thin, low resistivity films; zinc selenide films were suitable in all respects but resistivity. C.L.W.

N63-20950 Brown Engineering Co., Huntsville, Ala. Scientific Research Labs.
ELEMENTS OF THE BOHM AND PINES THEORY FOR COLLECTIVE EXCITATION OF PLASMONS IN METALS
H. J. Watson Aug. 1963 19 p 9 refs
(R-68)

Some aspects of the organized or collective behavior of the metallic free-electron gas are given in terms of the density fluctuations in the dense-electron gas. The components of density fluctuations are separable, and the separation corresponds to a splitting of the Coulomb interaction into a long-range and a short-range part; the separation occurs roughly at the Debye length. One component is associated with the organized oscillation of the system, the so-called plasma oscillation, and the other component is associated with the random thermal motion of the individual particles and shows no collective behavior. A general physical picture of the system is given. It is shown that when a charged particle moves through the electron gas at greater than the average thermal speed of the individual particles, it may excite collective oscillations. The frequency of the oscillations and the energy given up by the particle are predicted. Other properties of the oscillations are discussed. Author

N63-20954 Atomic Energy Commission, Bombay (India) Chemistry Div.
STUDIES OF THE ELECTRICAL PROPERTIES OF URANIUM OXIDES. 1. ELECTRICAL CONDUCTIVITY OF $\alpha-U_3O_8$
A. M. George and M. D. Karkhanavala 1963 23 p 18 refs
Submitted for Publication
(AEET/CD/13)

The electrical conductivity of two grades of $\alpha-U_3O_8$ (nuclear pure and spec-pure) was studied as a function of temperature and partial pressure of oxygen in the ranges of 50° to 850° C and 150 to 10^{-2} mm of Hg. The $\log_e$ vs. 1/T plots (for P_{O_2} = 150 mm) show two linear portions with a break at about 450° C. The temperature dependence of conductivity is represented by the equation $\sigma = \sigma_0 e^{-\epsilon/2KT}$ with activation energies of 0.64 ± 0.03 ev and 1.10 ± 0.02 ev below and above the transition point, respectively. In the high-temperature region σ_0 could be regarded as constant with an average value of 138.4 $(\omega-cm)^{-1}$ for the nuclear pure material. The logarithm of conductivity varied linearly with $\log P_{O_2}$ and the average slope of the plots was found to be 0.170 ± 0.006. The main features of conduction mechanism in the temperature range investigated are suggested. Author

N63-20965 Northwestern U., Evanston, Ill. Technological Inst.
CRYSTALLOGRAPHIC ANGLES FOR ALPHA MERCURY Technical Note No. 1
A. C. Arko, J. Cotner, and J. Weertman Aug. 1963 22 p 8 refs
(Contract AF 49(638)-1041)

Crystallographic (interplanar and interdirectional) angles for alpha mercury are presented. The lattice constants used in the computation of the angles are a = 2.9925 Å and γ = 70° 44.6'. Thermodynamically alpha mercury is unstable below 79° K but does not transform to beta mercury unless subjected to several thousand atmospheres of pressure. The space group of alpha mercury is $R\bar{3}$ m^5 and the angle γ is the acute angle of the rhombohedrons forming the faces of the primitive cell and is independent of temperature between liquid-nitrogen and liquid-helium temperatures. P.V.E.

N63-20974 Massachusetts Inst. of Tech., Cambridge Lab. for Insulation Research
PIEZOELECTRIC COUPLING BETWEEN ULTRASONIC WAVES AND FREE ELECTRONS IN CADMIUM SULFIDE
Kenneth W. Nill July 1963 23 p 14 refs
(Contract Nonr-1841(10))
(MIT-TR-181)

In some semiconductors, there is strong coupling between lattice waves and free electrons due to the piezoelectric effect. This coupling provides an energy-exchange mechanism from the electron system to the lattice system. This transfer is experimentally observed here as the amplification of an ultrasonic wave, and as an acoustoelectric current resulting from the wave-electron drag. Experimental results are presented which support an acoustoelectric-effect explanation of a kink in the current-voltage characteristics of piezoelectric semiconductors. Author

N63-20975 Tulane U., New Orleans, La.
Semi-Annual Progress Report, Oct. 1, 1962–Mar. 31, 1963 and Final Report, Oct. 1, 1960–June 30, 1963 [GROSS STRUCTURE AND STEREOCHEMISTRY OF DIMERS OF CYCLOBUTANE DERIVATIVE]
Gary W. Griffin Aug. 1, 1963 12 p 14 refs
(Contracts DA-ARO(D)-31-124-G389 and DA-ORD-31-124-61-G31)
(AROD-2914-13)

Direct irradiation of dimethyl fumarate in the solid state was shown to afford a single dimer *cis,trans,cis*-1,2,3,4-tetracarbomethoxycyclobutane(I) whose stereochemistry was rationalized in terms of direct bond formation between nearest neighbor molecules in the crystal lattice of the monomer. Isomerization of this dimer to the thermodynamically more stable *trans,trans,trans* tetraester II is readily achieved thermally.

The structures of the dimeric products were related chemically and a number of interesting derivatives synthesized, including tetramino- and tetrabenzoylcyclobutane. *Cis,cis,cis*-tetracarbomethoxycyclobutane (III) was synthesized by destructive ozonolysis of β-heptacyclene (IV). P.V.E.

N63-20990 Franklin Inst., Philadelphia, Pa.
A STUDY OF THE BEHAVIOR OF DISLOCATIONS AND THEIR INTERACTION WITH OTHER LATTICE DEFECTS UNDER CONDITIONS OF ALTERNATING STRESS [Final Report, Feb. 1, 1960–Jan. 31, 1963]
K. U. Snowden and H. H. F. Wilsdorf Wright-Patterson AFB, Ohio, Aerospace Res. Labs., July 1963 50 p 44 refs
(Contract AF 33(616)-6996)
(ARL-63-114)

In order to study the cyclic work-hardening of Al and Cu single crystals, two methods were used: (1) the accurate recording of stress–strain loops during cyclic straining, and (2) the direct observation of dislocation arrangements within crystals using transmission electron microscopy. The cyclic hardening experiments covered from one to 10^3 cycles of reversed plastic strain amplitude ($\gamma_p \leq 0.01 \geq 0.0004$) and were made in push/pull with special attention being given to achieving axial stresses. The stress–strain loops produced by the crystals during cyclic straining clearly showed the Bauschinger effect. The Bauschinger glide strain depended on the orientation and peak stress, and consequently varied systematically with the rate of hardening. Both the nonelastic strain, i.e., the strain at $\tau = 0$, and the Bauschinger glide strain increased peak stress. The anelastic behavior of crystals during unloading and reapplication of the load was used to obtain an estimate of the frictional resistance to dislocation movement after cyclic straining. The most prominent feature of the electron microscope observations on crystals after one or few cycles of alternating strain was the presence of dislocation tangles and long narrow dislocation loops parallel to <112>. The tangles appeared similar to those observed in Al after unidirectional deformation within the easy glide range. After the application of 100 cycles or more, the tangles were spread out in zones parallel to the glide plane with relatively few dislocations in between. The significance of the electron-microscope observations is discussed in relation to measurements of the Bauschinger glide strain, and the mechanism of cyclic hardening and softening. Author

N63-20995 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE OPTICAL MASER [DER OPTISCHE MASER]
W. Kaiser London, Ministry of Aviation May 1963 33 p 79 refs In ENGLISH Transl. from Phys. Stat. Sol. 2, 1962 p 1117–1143
(RAE Lib. Transl. 1037)

A review of the present knowledge of the optical maser has been carried out. The maser condition for certain resonant bodies is described, and a brief account of the kinetics of the solid-state maser is given. Recent work on the gas maser is reported, and the essential properties of the radiation of the solid-state maser and the gas maser are discussed. Some applications of optical masers are mentioned. Author

N63-21210 Atomics International, Canoga Park, Calif.
GROWTH OF BeO SINGLE CRYSTALS. III. STEADY-STATE THERMAL GRADIENT METHOD
S. B. Austerman Aug. 15, 1963 21 p 7 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8056) OTS: $0.50

The use of a steady-state thermal gradient method for growing single crystals in a molten flux has many advantages over more conventional methods. The flux system used for growth of BeO single crystals was Li_2MoO_4–MoO_3. The influence of temperature, thermal gradient, and flux composition parameters on crystal growth characteristics was experimentally delineated. Crystal habit, quality, and nucleation are influenced by, and are at least partially controlled by, these parameters. The significance of the data to crystal growth processes, and to the production of BeO single crystals, is discussed. Author

N63-21315 Technical Research Group, Inc., Syosset, N.Y.
SYNTHESIS OF SEMICONDUCTOR MATERIALS USING NUCLEAR RADIATION Final Report, May 1, 1959–Oct. 31, 1962
Kalman Held and Richard J. Goldman Jan. 1963 65 p 8 refs
(Contract AT(30-1)-2392)
(NYO-10472) OTS: $1.50

The gamma radiolysis of silane has been conducted at temperatures of from −195° C to 450° C in static and dynamic systems at various pressures. In-pile irradiations were conducted at temperatures from 100° C to 275° C. G values for the decomposition of silane of from 3000 to 35,000 have been achieved at high pressure. Qualitative evaluation of some of the deposited silicon reveals material of from 10 to 400 ohm-cm resistivities. Author

N63-21320 General Electric Co., Syracuse, N.Y. Advanced Semiconductor Lab.
SEMICONDUCTOR DEVICE CONCEPTS Scientific Report No. 48
June 28, 1963 14 p 6 refs
(Contract AF 19(638)-329)
(AFCRL-63-323(4B))

Some further experience and problems with contamination encountered in halogen vapor synthesis of $Ga(As_{1-x}P_x)$ crystals are described. The possibility of oxygen contamination of $Ga(As_{1-x}P_x)$ during vapor synthesis is discussed. Some experiments which bear upon the direct-indirect transition and lower wavelength possibilities of $Ga(As_{1-x}P_x)$ are described. Author

N63-21321 General Electric Co., Schenectady, N.Y. Research Lab.
SEMICONDUCTOR DEVICE CONCEPTS Scientific Report No. 4A
M. Aven et al June 28, 1963 68 p 34 refs
(Contract AF 19(628)-329)
(AFCRL-63-323(4A))

Injection electroluminescence has been observed in Cu_2S–ZnS and Cu_2Se–ZnSe heterojunctions. The light emission occurs through hole injection from the p-type Cu chalcogenide into n-type ZnS or ZnSe. A tentative model for the band structure of the Cu chalcogenide-II-VI compound heterojunctions is presented. Studies on the double acceptor center in CdS have continued, with the discovery that these centers can be produced by electron irradiation as well as by Cd firing. Some preliminary conclusions from studies of the diffusion of Cd in CdS are also presented. The junction laser threshold analysis has been extended. Author

26 PROPELLANTS AND COMBUSTION

Includes: fuels; igniters; and oxidizers.

For related information see: 07 Chemistry; and 27 Propulsion

N63-20830 Lockheed Propulsion Co., Redlands, Calif.
THERMAL STRESS INVESTIGATION OF SOLID PROPELLANT GRAINS. VOLUME 1 – THEORY AND EXPERIMENT
J. Jones, J. E. Fitzgerald, and E. Francis May 1963 143 p 7 refs
(Contract AF 04(611)-8103)
(LPC-578-F-1)

Volumes 1 and 2 present the formulation, theoretical solution, mathematical analysis, and experimental confirmation of the problem of stress analysis for a real viscoelastic, case-bonded solid-propellant grain subjected to an arbitrarily time-varying thermal input. A theoretical treatment of dynamic birefringence (photoviscoelasticity) is given. Author

N63-20831 Lockheed Propulsion Co., Redlands, Calif.
THERMAL STRESS INVESTIGATION OF SOLID PROPELLANT GRAINS. VOLUME 2 – MATHEMATICAL ANALYSIS
George Lianis and K. Vallanis (Purdue U.) May 1963 177 p 15 refs
(Contract AF 04(611)-8013)
(A&ES-62-19A; LPC-578-F-2)

An investigation into the problems of stress and deformation of linear viscoelastic solids under various environmental conditions, such as gravity, temperature, and inertial forces is presented. Approximate methods are developed for investigating thermal stresses in viscoelastic solids with temperature dependence limited to the thermorheologically simple type. The effects of the acceleration terms on the stress distribution in incompressible viscoelastic solids under conditions of nonuniform transient temperature and the problem of the horizontal slump of a viscoelastic hollow cylinder contained in a thin elastic shell and resting on a rigid horizontal plane are discussed. P.V.E.

N63-20837 Los Alamos Scientific Lab., N. Mex.
SOLID PLUTONIUM FUELS PROGRAM Quarterly Status Report, June 30, 1963
J. A. Leary, W. J. Maraman, W. N. Miner, and F. W. Schonfeld July 1963 24 p 19 refs
(Contract W-7405-eng-36)
(LAMS-2949) OTS: $0.50

Progress is reported on a program which was undertaken to investigate solid plutonium fuel compositions and their utilization in thermal, fast, and special-purpose nuclear reactors. The investigation included: (1) preparation of materials, (2) properties of materials, (3) physical metallurgy, (4) irradiation effects, (5) recycle and scrap recovery, and (6) analytical chemistry. Fuel materials under evaluation are divided into two classes: (1) alloys and compounds, and (2) dispersions. C.L.W.

N63-20910 Ohio State U., Columbus
PROPAGATION OF SPHERICAL COMBUSTION WAVES [Final Report, Mar. 1, 1961-Nov. 30, 1962]
J. W. Pliickebaum, W. A. Strauss, and R. Edse Wright-Patterson AFB, Ohio, Aeron. Res. Labs., June 1963 32 p 8 refs
(Contract AF 33(616)-8129)
(ARL-63-101)

Measurements were made of propagation rates of spherical combustion waves in gaseous explosive mixtures, in 65-cm diam. thin-walled rubber balloons and in a 40-cm diam. steel bomb. The propagation rates of stabilized spherical detonation waves were determined for acetylene-oxygen, hydrogen-oxygen, hydrogen-nitrous oxide and methane-oxygen mixtures. Acetylene-oxygen mixtures were studied in detail with particular attention given to the effect of ignition energy on the propagation rates. A high-speed strip-film camera was used to record the propagation of the combustion wave front. In all experiments, the explosive gas mixtures were initially at atmospheric pressure and room temperatures. The results of these experiments show that (1) the detonation induction distances in acetylene-oxygen mixtures are inversely proportional to the ignition energy; (2) for a given ignition energy, the detonation induction distances, for acetylene-oxygen mixtures containing more than 24% but less than 48% acetylene by volume, are practically independent of the mixture ratio; (3) combustion waves of all acetylene-oxygen mixtures were initially overdriven no matter how they were ignited; and (4) the propagation rates of stabilized spherical detonation waves were practically identical with the linear propagation rates observed in long tubes. Author

N63-20944 Sandia Corp., Albuquerque, N. Mex.
INVESTIGATION OF THE EFFECT OF DELAY BODY VARIABLES ON THE BURNING CHARACTERISTICS OF TUNGSTEN DELAY COMPOSITIONS
R. H. Comyn and R. E. Mc Intyre Aug. 1963 14 p 2 refs
Prepared in Oct. 1961 under Order ASD-14-9986 to Diamond Ordnance Fuze Labs.
(SC-4791(RR)) OTS: $0.50

Investigation of the effect of delay body variables on the burning characteristics of tungsten delay compositions resulted in the following conclusions: (1) The effect of increasing the mass of the delay body is to slow the burning of the composition. If other conditions permit using a massive delay body, a shorter column can be used, but too massive a body can result in failures of very slow burning mixtures at low temperature. (2) Ceramic delay bodies offer some advantages for long delays, since the accelerated burning in long columns appears to be due to preheating of the unburned material by heat flowing through the delay body. This effect has been pronounced in designs having multiple columns, and ceramic should be considered for such designs. (3) Preliminary data indicate that the use of small diameter columns may reduce dispersions, but no practical method has been found which offers reliable function at low temperature. P.V.E.

N63-20951 General Dynamics Corp., San Diego, Calif. General Atomic Div.
AN EIGENVALUE METHOD FOR THE CALCULATION OF NUCLEAR BURNUP
G. D. Joanou, J. R. Triplett, and R. M. Wagner June 12, 1963 20 p 2 refs Submitted for Publication
(GA-4140)

An iterative approach to the reactor burnup problem is developed on the basis of analytical solutions for the variable-coefficient burnup equations. The time dependence of the depletion matrices, A(t), is approximated by a polynomial representation. The number of basic time points for which spatial-diffusion calculations during burnup are required is determined only by the order of approximation necessary to give a reasonably good fit for the time dependence of A(t). Usually a low-order approximation is sufficient, so the number of diffusion calculations is reduced to a minimum. The method is applicable both to survey-type calculations and to detailed reactor-burnup studies. A comparison of some results obtained with the method described in this paper and with standard calculational methods is given for a typical example. The results show the rapid convergence and accuracy of the proposed procedure. Author

N63-20992 Naval Ordnance Lab., White Oak, Md.
TWO EXPLOSIVES GENERATING CONDENSIBLE PRODUCTS
M. F. Murphy Sept. 1963 47 p 9 refs
(NOLTR 63-12)

Permanent reaction products and some explosive properties of two compositions were studied to establish detonability and the postdetonation equilibrium products. The compositions were based on aluminum–aq hydrogen peroxide (98%) and aluminum–lithium perchlorate trihydrate. Stable detonation rates were measured for well-confined compositions of both types, balanced to alumina and steam. The concentration of hydrogen in the reaction products of a series of aluminum–hydrogen peroxide charges with oxygen balances rising toward zero, decreased and became negligible. Experimental results from these charges were compared with Ruby Code calculations of reaction products for a charge balanced to alumina and steam, and also with data from experiments with water-immersed torpexes. The reaction products from a single charge of aluminum–lithium perchlorate were discussed. The detonation rate of aqueous hydrogen peroxide (97.5%) was measured and compared with values found in prior German work and with a Ruby Code calculation. The gap sensitivity of aqueous hydrogen peroxide (97.5%) was measured. Author

N63-21007 Wissenschftliche Gesellschaft für Luft- und Raumfahrt, Cologne (W. Germany)
PROPELLANTS AND ROCKET TECHNOLOGY [TREIBSTOFFE UND RAKETENTECHNIK]
A. Dadieu and K. Dreyer 17 p In GERMAN Proc. of the Joint Meetings of the Comms. on Propellants and Rocket Technology, Ottobrunn, Mar. 3, 1962
(WGL-2/1962)

Abstracts are presented of the following speeches: (1) High-Performance Liquid-Propellants for Rockets; (2) Liquid-Fluorine Rocket Propellants; and (3) Production and Handling of Liquid Fluorine. I.v.L.

N63-21020 Southwest Research Inst., San Antonio, Tex.
SHOCK AND HYPERVELOCITY STUDIES IN A SOLID PROPELLANT DRIVEN TUNNEL Final Report
M. L. Whitfield, E. M. Briggs, R. K. Gregory, B. W. Vanzant, and R. C. De Hart Apr. 16, 1963 129 p 12 refs
(Contract DA-49-146-XZ-062)
(DASA-1378)

Shock waves superposed on hypervelocity flow in a solid-propellant driven tunnel were used to simulate the conditions experienced by a reentry vehicle encountering a blast wave. The flow velocity and high stagnation temperatures produced were measured using currently available techniques. Author

N63-21033 Aberdeen Proving Ground, Md. Ballistic Research Labs.
A SUMMARY OF RECENT COMBUSTION INSTABILITY RESEARCH IN SOLID ROCKET PROPELLANTS AT THE BRL
Leland A. Watermeier, Richard C. Strittmater, William P. Aungst, Samuel P. Pfaff, and Clifton E. Thompson July 1963 27 p 17 refs
(BRL-MR-1489)

A summary is presented of progress made in the solid-propellant combustion instability program. Recent developments in the acoustic-admittance measurements are presented; a description of the apparatus and experimental objectives of a program on acoustic erosivity effects on propellant burning rates are given; and outside contract work on combustion instability which is supervised by BRL is reviewed. Author

N63-21071 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
HYDRAZINE MONONITRATE IN HYDRAZINE, SUPPLEMENTAL PHYSICAL DATA
Stephen P. Vango and John B. Krasinsky Mar. 24, 1963 15 p 1 ref
(NASA Contract NAS7-100)
(NASA CR-50970; JPL-TM-33-122) OTS: $1.60 ph, $0.80 mf

The density, vapor pressure, viscosity, and freezing point are reported for a solution of hydrazine mononitrate dissolved in hydrazine with approximately 1% water added. Author

N63-21112 Southwest Research Inst., San Antonio, Tex.
AN EXPERIMENTAL DRAG FACILITY Final Report
M. L. Whitfield, E. M. Briggs, R. K. Gregory, and R. D. De Hart Mar. 15, 1963 156 p 57 refs
(Contract DA-49-146-XZ-062)
(DASA-1369)

Experiments performed show that solid propellants can substantially supplement and prolong the positive pressure pulse in a standard shock tube, provided that proper design and operational procedures are observed. The extra energy from the solid propellant allows for expedient simulation of nuclear-blast-wave conditions within the tube. Three types of solid-propellant rocket motors from standard stock were utilized. Pressure, temperature, and velocity characteristics of gas flow generated by the motor, and discharged through a nozzle into the tube, were recorded as a function of time at several locations down the tube. In addition, a unique technique for generating a shock wave at a preselected time during the high-velocity gas flow was developed. Author

N63-21219 Aberdeen Proving Ground, Md. Ballistic Research Labs.
COMBUSTION AIR HEATER
Ernest P. Reklis June 1963 86 p 6 refs
(BRL-TN-1505)

The combustion heater is a unit in the hypersonic wind-tunnel air circuit used to add heat to the air prior to the air entering an electric air heater, which in turn acts as a vernier control of the air temperature before the air enters the hypersonic nozzle. The intent of this report is to provide a manual for the operation of the combustion heater. Author

N63-21290 Frankford Arsenal, Philadelphia, Pa.
PROPELLANT ACTUATED DEVICE (PAD) ASSISTED PARACHUTE SYSTEM FOR AERIAL DELIVERY OF CARGO Technical Summary Report
C. J. Litz, Jr. Mar. 1963 126 p 4 refs
(Rept. R-1671)

A study was made to determine the feasibility of using existing propellant-actuated device (PAD) type rockets and other appurtenances, such as ground-sensor and safe-arming systems, to reduce the ground contact velocity of air-delivered cargo. Specifically considered were cargo loads in the range of 2000 to 35,000 lb which were decelerated by parachute to a velocity of 40 to 60 fps; then, by the use of PAD-type retrorockets, the velocity was to be further reduced to 25 fps just prior to ground contact. Results of the study indicated that an aerial recovery system consisting of parachutes and PAD type retrorockets can provide a reduction of approximately 60 percent in weight and volume and, also, provide a saving in cost when compared to the all-parachute recovery system. Author

27 PROPULSION

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

For related information see: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N63-20912 Marquardt Corp., Van Nuys, Calif. Astro Div.
RESEARCH ON EXPERIMENTAL EVALUATION OF SPUTTERING YIELD RATES
K. B. Cheney, E. E. Rogers, and E. T. Pitkin Wright-Patterson AFB, Ohio, Aerospace Research Labs., July 1963 99 p 192 refs
(Contract AF 33(616)-8120)
(ARL-63-125)

Phenomena associated with the interaction of high-energy ions and solid surfaces under conditions relevant to ion rocket operation have been investigated. The number of target atoms removed per incident ion, or sputtering ratio, has been determined for xenon and argon ions incident on copper, tungsten, molybdenum, silicon, and titanium with energies from 1,500 to 39,000 ev, and at incidence angles from 2° to normal incidence. The effect of target temperatures, both high and low, on the sputtering ratio has been investigated. The ratio of secondary particles produced to incident ions, along with their energy and angular distribution, has been investigated as functions of ion energy and incidence angle. Areas investigated for the first time in this program include: (1) sputtering and secondary emission for very low angles of ion incidence, and effects of surface roughness; (2) the energy and angular distributions of secondary particles as a function of beam incidence angle; (3) sputtering and secondary emission of surface at reduced temperatures. Analysis of theoretical concepts of sputtering and existing empirical data have led to recommendations of likely materials for ion rocket use. A bibliography of relevant papers has also been compiled. Author

N63-21043 Marquardt Corp., Van Nuys, Calif.
THRUST CHAMBER COOLING TECHNIQUES FOR SPACECRAFT ENGINES. VOLUME I: EVALUATION PROCEDURE AND ANALYSES Final Report, 13 Feb. 1962-12 Feb. 1963
D. R. Batha, M. D. Carey, J. G. Campbell, and C. D. Coulbert July 15, 1963 102 p 14 refs
(NASA Contract NAS7-103)
(NASA CR-50958; Rept. 5981, Vol. I) OTS: $9.10 ph, $3.26 mf

Thrust-chamber cooling concepts developed include regenerative or convective cooling, radiation cooling, film or transpiration cooling, ablation, and inert or endothermic heat sinks. This report outlines the procedure proposed for evaluating the cooling requirements for a liquid-rocket space engine, and provides analyses and data for selecting the applicable and best cooling techniques. Four specific examples of propulsion requirements are used to demonstrate the cooling-technique selection procedure. Author

N63-21067 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SPACE POWERPLANT NEEDS AND SELECTION
D. T. Bernatowicz, D. C. Guentert, and J. L. Klann Repr. from Astronautics and Aerospace Eng., May 1963 p 22-26 Previously announced as a preprint, see X63-11546 08-06

The overall power requirements of our more ambitious space missions, and the factors governing powerplant selection for space applications are reviewed. The anticipated maximum requirements for nonpropulsive and propulsive electric power are plotted against calendar year, demonstrating the need for a wide power spectrum varying from 10 kw for satellites and space probes up to 1 mw for unmanned probes of Jupiter. Electric propulsion imposes even more difficult requirements due to the duration of the anticipated space missions. Criteria for evaluating and selecting space power systems discussed include mass, ease of integration into the complete vehicle system, compatibility with the space environment, lifetime and reliability, hazard to human life, cost, and availability or status of technology. These criteria are used in a discussion of the relative merits of chemical-, solar-, and nuclear-electric power systems. Because powerplants influence many aspects of mission planning, the relationships between the two must be understood far in advance of application time. M.P.G.

N63-21074 Marquardt Corp., Van Nuys, Calif.
THRUST CHAMBER COOLING TECHNIQUES FOR SPACECRAFT ENGINES, VOLUME II Final Report, 13 Feb. 1962-12 Feb. 1963
J. G. Campbell, D. R. Batha, M. D. Carey, A. R. Nagy and R. C. Stechman July 15, 1963 313 p 226 refs
(NASA Contract NAS7-103; Proj. 278)
(NASA CR-50959; Rept. 5981, Vol. II) OTS: $19.75 ph, $9.59 mf

This volume presents thrust-chamber design data and design approaches for basic engine-cooling techniques. Data on propellants and thrust chamber materials are included, as well as additional data on space-mission propulsion requirements, and a bibliography of reports on rocket cooling and related topics. Author

N63-21122 Hughes Research Labs., Malibu, Calif.
OPTIMIZATION OF ION ENGINE CONTROL SYSTEMS FOR SYNCHRONOUS SATELLITES
J. H. Molitor and M. H. Kaplan N.Y., Am. Inst. of Aeron. and Astronautics [1963] 32 p 7 refs Presented at the AIAA Summer Meeting, Los Angeles, June 17-20, 1963
(NASA Contract NAS3-2510)
(AIAA Paper 63-273) AIAA: $0.50 members, $1.00 non-members

The first contemplated use of ion thrust devices is in the control of synchronous earth satellites. This paper presents the results of a study concerning the magnitude and nature of the major forces (e.g., solar-lunar and earth's triaxiality) which perturb the orbit of a synchronous satellite. From the results of this study the optimum design and mode of operation of an ion propulsion station-keeping system is determined. A comparison of the system weight for both pulsed-mode and continuous-mode operation is presented, which shows the distinct advantage of a continuous correction with a relatively low-thrust ion engine. In addition, the tradeoffs between the critical mission and system parameters are provided, from which the capabilities and requirements of both the attitude control and station-keeping systems can be determined for application over a wide range of satellite weights. Author

N63-21155 National Aeronautics and Space Administration. Washington, D.C.
NUCLEAR PROPULSION – AN EMERGING TECHNOLOGY
Harold B. Finger *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963 p 273-282 (See N63-21126 21-01)

The application of nuclear energy to the space program is reviewed. The reactor technology obtained from the KIWI

reactor project will be used in the development of a flight propulsion system in the NERVA project. The NERVA propulsion system will be flight tested in the RIFT stage. The RIFT stage will be designed to fit the SATURN V launch vehicle in such a way that, with continued development, an early operational capability will be realized. In addition to nuclear energy for nuclear rocket propulsion, nuclear energy for electric power and electric propulsion will be required. In the range of hundreds of kilowatts to many megawatts, the only practical source of long-life electrical power is nuclear energy. Applications of such power levels include orbiting manned space platforms, communications satellites, manned interplanetary spacecraft, and unmanned planetary probes. These applications can generally be divided into the needs for on-board power for communications, life support, data acquisition, etc., and the power required for electric propulsion. I.v.L.

N63-21156 Michigan U., Ann Arbor Coll. of Engineering
THE FEASIBILITY OF A ROTATING DETONATION WAVE ROCKET MOTOR Quarterly Progress Report No. 1, 1 June 1962-31 Aug. 1962
J. A. Nicholls, R. E. Cullen, G. L. Cosens, M. Sichel, E. Kurath et al Aug. 1962 53 p 38 refs
(Contract AF 04(611)-8503)

Progress reported is as follows: (1) A study of the structure of a detonation wave through a two-phase medium—fuel droplets in an oxidizer atmosphere or oxidizer droplets in a fuel atmosphere—has yielded some tentative results. It is indicated that droplet shattering could be influential in furnishing sufficiently small droplets to allow for the attainment of a stable detonation wave. (2) A study of the heat transfer to the wall of a rotating detonation-wave combustion chamber, for the simplified model considered, has resulted in the preliminary conclusion that the heat transfer is of the same order as that encountered in the throat section of a conventional rocket engine. Also, it appears that the fluctuation of the wall temperature will be negligible for the case considered. The following experimental studies are, for the most part, in the instrumentation and setup phase: (1) a study of the pressure and temperature effects on the detonation-wave properties of a hydrogen—oxygen mixture; (2) the consideration of the effect of geometry on the propagation characteristics of a detonation wave for the purpose of designing a final test model of a rotating detonation-wave rocket motor; and (3) a study of detonation waves in heterogeneous media. I.v.L.

N63-21191 Michigan U., Ann Arbor Aircraft Propulsion Lab.
THE FEASIBILITY OF A ROTATING DETONATION WAVE ROCKET MOTOR Quarterly Progress Report No. 2, Sept. 1, 1962-Nov. 30, 1962
J. A. Nicholls et al Dec. 1962 70 p 20 refs
(Contract AF 04(611)-8503)

The study of the structure of a detonation wave through a two-phase medium emphasizes the droplet shattering mechanism. Utilizing a theoretical relation for a shear-type breakup developed by Dodd, it is concluded that the distance predicted for droplet breakup behind the strong, normal shock wave associated with an H_2-O_2 detonation can be much smaller than experimentally observed distances between the shock and the zone of significant chemical reaction. The study of the heat transfer to the wall of a rotating detonation wave engine has been continued. For the case of dissociative recombination at the wall, the conclusions are that the heat flux to the wall is increased about 35 percent over the case without dissociative recombination studied earlier. Curves are presented showing this effect as a function of the mole-fraction of H_2 present in the unburned gases. The study of an analytical model for the gasdynamics associated with the rotating detonation wave engine has been initiated. Instrumentation has been essentially completed on the 100-lb-thrust motor, and initial runs have been made. The studies of the pressure and temperature effects on detonation velocities have progressed to the point of substantiating the data of Moyle down to 160° K at a pressure of one atmosphere. Instrumentation of the condensation chamber for the study of droplet formation by rapid expansion and condensation is almost complete. The geometrical tests performed to date have investigated the wave structure of detonations in a curved tube without side relief. It is concluded that a multiply reflected wave occurs in the burned gases behind H_2-O_2 detonation waves in nearly stoichiometric mixtures. Also, the initial wave front is slightly inclined to the radial direction. Author

N63-21253 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SELECTION OF POWER REQUIREMENTS FOR NUCLEAR-ELECTRIC SPACECRAFT MISSIONS
Jerry P. Davis May 24, 1961 17 p
(NASA Contracts NASw-6 and NAS7-100)
(NASA CR-51018; JPL TR 32-114) OTS: $1.60 ph, $0.80 mf

A Mars orbiter mission is taken as an illustrative example of the basis approach. Having selected launched vehicle, payload, and flight time, the distribution of powerplant and propellant weight is discussed. Curves are presented which indicate the minimum power requirement for the mission, the power range which affords maximum powerplant design flexibility, and the powerplant specific weights which must be attained to accomplish the mission. The interplay between mission requirements and powerplant development is indicated. The paper concludes with the indication that a nuclear-electric plant, in the power range of 100 kwe propulsion at a specific weight in the range of 35 lb/kwe, can accomplish a useful Mars orbiter mission in a reasonable flight time, while delivering a useful scientific payload. Data are also presented for two Jupiter missions. Author

N63-21324 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
FUSION PROPULSION SYSTEM REQUIREMENTS FOR AN INTERSTELLAR PROBE
Dwain F. Spencer May 15, 1963 16 p 7 refs
(NASA Contract NAS7-100)
(NASA CR-50964; JPL-TR-32-397) OTS: $1.60 ph, $0.80 mf

An examination of the engine constraints for a fusion-propelled vehicle indicates that minimum flight times for a probe to a 5-light-year star will be approximately 50 years. The principal restraint on the vehicle is the radiator weight and size necessary to dissipate the heat which enters the chamber walls from the fusion plasma. Theoretically, the confining magnetic field strength is of reasonable magnitude, 2 to 3 × 10^5 gauss, and the confinement time is approximately 0.1 sec. Author

28 SPACE RADIATION

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

For related information see: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N63-20863 Chicago U., Ill. Laboratories for Applied Sciences
SCATTERED RADIANCE IN THE MIDDLE ULTRAVIOLET REGIONS
George R. Ban *In its* Symp. on Military Applications of Ultraviolet Radiations. Wash., D.C., July 14–15, 1960 p 161–172 4 refs This paper was not presented at Symp. (See N63-20851 21-23)

The object of this study was to estimate the scattered solar radiance in the spectral interval from 2450 to 2850 Å in the middle ultraviolet, where the absorption due to ozone is high and reduces the extent of scattering. Since scattering is expected only at high altitudes, it was assumed to be predominantly single and Rayleigh scattering. The analysis on which the computation was based and the computation itself are described; the results indicate that for the sun and observer at the zenith position, the scattered radiance between 2450 and 2850 Å is approximately 2.44×10^{-7} w/cm^2/steradian, and that very little of the sun's radiation in this spectral region will penetrate below 30 km. Author

N63-20925 Uppsala U. (Sweden) Inst. of Physics
EXPERIMENTAL EVIDENCE OF A DIRECTIONAL EVENT DURING THE COSMIC RAY STORM IN DECEMBER 1957 Technical Note No. 2
Oscar L. Troncoso May 1963 30 p 18 refs
(Contract AF 61(052)-614)
(AFCRL-63-855)

On December 22–24, 1957, a significant cosmic-ray increase of short duration took place in the interval between two moderate magnetic storms, and during the recovery of a cosmic-ray storm. Data have been used from 24 cosmic-ray stations distributed all over the world. The increase was observed only by stations contained within a limited region of the earth's surface. The increase, which lasted for about 14 hours, took place at about the same local time for all stations which detected it. The average direction of the arriving particles corresponded to 10 hours l.t. A second peak, occurring at all stations at about 03 hours l.t., is interpreted as a continuation of the effect generating the first increase. Characteristic features of both increases are presented, together with data of solar and terrestrial activity. There is no clear correlation between the occurrence of these peaks and such activities. The modulation mechanism producing the increase is discussed. Author

N63-21003 National Science Foundation, Washington, D.C.
1964 U.S. ANTARCTIC RESEARCH PROGRAM INCLUDES U.S. – SOVIET COSMIC RAY STUDY
Gene Rodgers Sept. 4, 1963 12 p
(NSF-63-137)

United States and Soviet scientists will cooperate in Antarctica this year in a large-scale investigation of cosmic rays, the high energy particles that continually bombard the earth, according to the National Science Foundation. The object of the study is to detect distinct solar cosmic-ray events and to investigate their variations in energy, time, and location. The research will be part of the U.S. contribution to the International Years of the Quiet Sun (IQSY) 1964–1965, a period of minimum solar activity. The project will require construction of huge, steel antenna towers ranging in height from 105 to 190 ft at the South Pole and two other U.S. stations, and as yet, at an undetermined number of Russian stations. There is a possibility that other nations with Antarctic bases may also participate in the project. P.V.E.

N63-21063 Yale U. Observatory, New Haven, Conn.
OBSERVATIONS BEARING ON THE MECHANISM OF JOVIAN DECAMETRIC EMISSION
James N. Douglas and Harlan J. Smith Repr. from Mem. Soc. Roy. Sci., Ser. 5, v. 7, (1963) p 551–562 8 refs
(NASA Grant NsG 73-60)

The mechanism of Jovian decametric emission is discussed with respect to the following areas: rotation period and its constancy, polarization anomalies, and power and energy associated with decameter storms. P.V.E.

N63-21108 Rochester U., N.Y.
THE INFLUENCE OF IONIZATION LOSS ON THE SHAPE OF THE DIFFERENTIAL PRIMARY COSMIC RAY ENERGY SPECTRUM
M. V. K. Appa Rao (Tata Inst.) and M. F. Kaplon July 30, 1962 33 p 17 refs Submitted for Publication
(Contract AT(30-1)-875)
(NYO-10240)

The effect of ionization loss on a primary cosmic ray spectrum is calculated for H^1, Be^9, C^{12}, F^{19}, Al^{27}, Ca^{40}, and Fe^{56} as representative of the charge spectrum of primary cosmic rays. The calculation is carried out for passage through 2, 4, 6, and 10 gm/cm^2 of hydrogen, and also for a model in which the amount of material traversed is inversely proportional to the momentum. The observable effects obtained, i.e., the shift of the maximum toward higher velocity with increasing Z, and the relative enrichment of the lighter nuclei/energy interval at low energies, are compared with the experimental data obtainable. Some discussion of the origin of cosmic rays is given. Author

N63-21240 Goodyear Aerospace Corp., Akron, Ohio
SOLAR REFLECTOR FOAMING TECHNOLOGY Third Quarterly Progress Report [May 1, 1963–July 31, 1963]
Sept. 1963 33 p 2 refs
(Contract AF 33(657)-10165)
(GER 11234)

Work was concentrated to a large extent on evaluation of two-foot-diameter models. Eight of these units were foam-rigidized in the 250,000-foot-altitude space chamber. The goal of this work was to develop the technique required to produce a reflector model with contour and surface conditions satisfactory for a solar concentrator. The eighth mirror produced has a structure which appeared to satisfy the established requirements. Author

N63-21242 Rochester U., N.Y.
ISOTOPIC ANALYSIS OF PRIMARY COSMIC RADIATION
M. V. K. Appa Rao Aug. 15, 1962 14 p 13 refs Submitted for Publication
(Contract AT(30-1)-875)
(NYO-10243)

It is proposed that the characteristics of nuclear interactions of primary cosmic ray nuclei (in-out interaction) be used to obtain the isotope abundance ratios for different charges. The application of the procedure to singly and doubly charged nuclei is discussed. Author

N63-21254 High Altitude Observatory, Boulder, Colo.
SOLAR RADIO EMISSION. SPECTRAL OBSERVATIONS IN THE DECAMETER RANGE, 24 JULY 1959-28 FEBRUARY 1961
J. W. Warwick July 1, 1963 54 p
(Supported by NASA)
(NASA CR-51033; IGY Solar Activity Rept. Ser. 23) OTS: $5.60 ph, $1.82 mf

Data from spectral observations of solar radio emission in the decameter range are presented. Tables contain the date, type, time, intensity, and frequency range of the observations. P.V.E.

N63-21277 Southwest Center for Advanced Studies, Dallas, Texas
TERMINATION OF SOLAR WIND AND SOLAR MAGNETIC FIELD
W. I. Axford (Defense Res. Board, Ottawa, Canada), A. J. Dessler, and B. Gottlieb (Phys. Res. Lab., Ahmedabad, India) May 15, 1963 12 p 35 refs Repr. from Astrophys. J., v. 137, no. 4, May 15, 1963 p 1268–1278
(NASA Grant NsG-269-62; Contract AF 19(604)-7989)

The solar magnetic field is twisted into an Archimedes spiral by the outward-flowing solar wind; this spiral field must also, on the average, co-rotate with the sun, in order for the solar wind to move radially outward without cutting magnetic field and interstellar medium results in the formation of a shock wave at a heliocentric distance of the order of 50 au. Beyond the shock, the energy of the solar wind is transferred to the interstellar, neutral atomic hydrogen by charge exchange. Instabilities at the boundary between the solar plasma and the galactic medium cause blobs of solar plasma to form which are disconnected from the solar magnetic field by Sweet's mechanism; oppositely directed lines of force are joined to make large semipermanent magnetic "tongues." The solar-wind energy that is transferred to neutral hydrogen is transported out into the galaxy by radiation or thermal conduction. It is found that the solar magnetic field does not permit solar-wind velocities less than about 100 km/sec. Author

29 SPACE SCIENCES

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N63-20757 Massachusetts Inst. of Tech., Cambridge
STATISTICAL FILTERING OF SPACE NAVIGATION MEASUREMENTS
James E. Potter and Robert G. Stern N.Y., Am. Inst. of Aeron. and Astronautics [1963] 13 p 8 refs Presented at the AIAA Guidance and Control Conf., Cambridge, Mass., Aug. 12–14, 1963
(NASA Contract NAS9-153 and NASA Grant NsG-254-62) (AIAA Paper 63-333) AIAA: $0.50 members, $1.00 nonmembers

The criteria that have been used for designing an estimator which computes the state vector of a space vehicle from redundant navigational measurements are reviewed and compared. It is shown that under the assumption of linearity, all these criteria lead to the same estimator (or filter). If all measurement uncertainties have Gaussian distributions, it is shown that the estimate obtained from optimum filter theory is identical with the maximum likelihood estimate. A proof is presented that the Bayes estimator, which is biased in favor of the initial conditions, leads to the same result that would be obtained from an unbiased estimator to which six pseudo-measurements, representing the initial conditions, have been added. Although the theory has been applied in the specific area of space navigation, the results obtained are generally applicable to the estimation of multidimensional random variables. Author

N63-20760 Republic Aviation Corp., Farmingdale, N.Y.
TWO FIXED CENTER APPROXIMATIONS TO THE RESTRICTED PROBLEMS
Mary Payne N.Y., Am. Inst. of Aeron. and Astronautics, 1963 30 p 1 ref Presented at the AIAA Astrodynamics Conf., Yale U., New Haven, Conn., Aug. 19–21, 1963
(NASA Contract NAS8-2605)
(RAC-1645; AIAA Paper 63-390) AIAA: $0.50 members, $1.00 nonmembers

A perturbation theory of the two-fixed-center problem leading to an approximation of the restricted three-body problem in three dimensions is developed. The generalization used in this investigation consists of deriving perturbation equations for the initial conditions in a coordinate system rotating about an accelerated origin which is selected in such a way as to minimize the effects of the nonintegrable terms in the perturbation equations. Several procedures for the determination of the origin are discussed. A second perturbation theory is also formulated in an inertial coordinate system. In this theory, fixed positions for the earth and moon are selected so as to reduce the effect of the nonintegrable terms in the perturbation equations. The results of some numerical calculations are presented, showing the range of validity of the theory for typical initial conditions at launch from the earth, at closest approach to the moon, and at various midcourse positions along both the earth-to-moon and moon-to-earth portions of a lunar trajectory. Author

N63-20761 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TRAJECTORY DESIGN FOR RANGER AND MARINER MISSIONS
Victor C. Clarke, Jr. N.Y., Am. Inst. of Aeron. and Astronautics, 1963 6 p 7 refs Presented at the AIAA Astrodynamics Conf., Yale U., New Haven, Conn., Aug. 19–21, 1963
(NASA Contract NAS7-100)
(AIAA Paper 63-408) AIAA: $0.50 members, $1.00 nonmembers

A general description of the trajectory design problem for lunar and interplanetary missions is presented, and the trajectory selection process for the Ranger 3, 4, and 5 missions is described to exemplify the interrelationships between spacecraft design, mission objectives, and trajectory design. Subsets of suitable trajectories are selected from the almost limitless possible trajectories using conic approximation computer programs, and then improved in a constant iterative process which occurs between constraints of spacecraft design and trajectory design. The constraining factors discussed for the Ranger missions include flight time, launch date, launch time, landing location on the moon, and retrovelocity increment. M.P.G.

N63-20762 Analytical Mechanics Associates, Inc., Uniondale, N.Y.
A TRAJECTORY OPTIMIZATION TECHNIQUE BASED UPON THE THEORY OF THE SECOND VARIATION
Richard E. Kopp, H. Gardner Moyer (Grumman Aircraft Eng. Corp.), and Henry J. Kelly N.Y., Am. Inst. of Aeron. and Astronautics, 1963 16 p 22 refs Presented at the AIAA Astrodynamics Conf., Yale U., New Haven, Conn., Aug. 19–21, 1963
(NASA Contract NAS9-1147; Contract AF 49(638)-1207)
(AIAA Paper 63-415) AIAA: $0.50 members, $1.00 nonmembers

A successive approximation method based upon the theory of the second variation is developed. In the early stage of computation, the process behaves much like the gradient/penalty function process, with boundary conditions met only approximately. In the terminal stage, convergence more rapid than

that of a gradient method is achieved with "exact" satisfaction of boundary conditions an integral part of the process. Since the Euler–Lagrange equations of variation are employed in the computational scheme, only slight additional effort is required to perform a check of the generalized Jacobi (Mayer) condition. Author

N63-20834 Harvard Coll. Observatory, Cambridge, Mass.
THE TEMPERATURE DISTRIBUTION IN A STELLAR ATMOSPHERE Scientific Report No. 6
E. H. Avrett and Max Krook June 1963 11 p 8 refs
(Contract AF 19(604)-4545)
(AFCRL-63-829)

An iterative perturbation method for the determination of the temperature distribution in a plane-parallel pure absorption atmosphere is described. The method is unrestricted by the nature of the absorption coefficient and is rapidly convergent. Author

N63-20835 Denver Research Inst., Colo.
VARIATION OF THE INFRARED SOLAR SPECTRUM BETWEEN 2800 cm^{-1} AND 5100 cm^{-1} WITH ALTITUDE Scientific Report No. 2
David G. Murcray, Frank H. Murcray, and Walter J. Williams July 15, 1963 18 p 7 refs
(Contract AF 19(604)-7429; ARPA Order 363-62)
(AFCRL-490)

A prism spectrometer capable of scanning the region from 2800 cm^{-1} to 5100 cm^{-1} was flown on a balloon in conjunction with a biaxial pointing control. Spectra were obtained at various altitudes from the ground through 23 km. These data are presented. The experimental results are compared with the spectra calculations. The total absorptions are also compared with predicted theoretical values. Author

N63-20877 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DYNAMIC ENVIRONMENT OF SPACE
John C. New *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 1962 70 p 13 refs (See N63-20876 21-33)

A general review of the dynamic environment of space is presented. A summary of space activity of both the U.S. and the U.S.S.R. is included to demonstrate the advances in spacecraft design and instrumentation which accompany increased knowledge of the space environment. Sounding rockets and satellites have been the chief tools in defining the space environment, and the data obtained on the structure of the atmosphere, electromagnetic radiation, the ionosphere, magnetic fields, radiation belts, cosmic rays, micrometeorites, and planetary environments are reviewed. In addition, induced environments which are dependent upon the spacecraft, its operation, and its interaction with the natural environment are discussed. Technical problems associated with simulating space vacuum, solar radiation, energetic particle radiation, and reduced gravity and weightlessness are considered. M.P.G.

N63-20929 National Aeronautics and Space Administration, Washington, D.C.
ADDRESS: PLANS AND PROGRAM EVALUATION – NATIONAL AERONAUTICS AND SPACE ADMINISTRATION News Release
Addison M. Rothrock Sept. 14, 1963 24 p refs Presented to the Iowa City Daily Press Assoc., Des Moines
Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

The accomplishments and goals of our national space program are discussed. The major accomplishment to date is having learned the techniques required to achieve reliability in space while continually extending the operating range and operating flexibility of our spacecraft. The progress made in space by sending instrumented craft into the vicinity of the phenomena to be explored is reviewed, and the civil applications of space technology in such areas as communications and meteorology are discussed. Manned flight in space and its implications for space law, national security, and foreign policy are also discussed. In conclusion, a plea is made for factual and intelligent press coverage of the space program developments. M.P.G.

N63-20930 California U., Berkeley
DIRECT CONTACT AMONG GALACTIC CIVILIZATIONS BY RELATIVISTIC INTERSTELLAR SPACEFLIGHT
Carl Sagan (Harvard U.) Repr. from Plant. Space Sci. v. 11, 1963 p 485–498 Presented at the Am. Rocket Soc. 17th Ann. Meeting, Los Angeles, Nov. 15, 1962
(NASA Grant NsG-126-61)

Interstellar spaceflight at relativistic velocities has several obvious advantages over electromagnetic communication among galactic civilizations. One striking feature is that with uniform acceleration of 1 g to the midpoint of the journey, and uniform deceleration thereafter, all points in the Galaxy are accessible within the lifetime of a human crew, due to relativistic time dilation. Some of the technical problems in the construction of starships capable of relativistic velocities are discussed. It is concluded that with nuclear staging, fusion reactors, and the Bussard interstellar ramjet, no fundamental energetic problems exist for relativistic intestellar spaceflight. Author

N63-20999 Aerojet-General Corp., Azusa, Calif.
ROCKETS IN SPACE ENVIRONMENT. VOLUME I – THE EXPERIMENTAL PROGRAM Final Report
P. D. Gray, G. K. Cornelius, J. D. O'Donnell, and W. W. Howard Edwards AFB, Calif., Rocket Propulsion Lab., Feb. 1963 260 p 41 refs
(Contract AF 04(611)-7441)
(RTD-TDR-63-1050; Aerojet-2484, Vol. I)

Environmental factors constituting the space environment between 300 and 22,000 n.mi. altitude were defined. These factors included radiation (ultraviolet, infrared, and penetrating), micrometeoroids, vacuum, and zero gravity. The effects of simulated space-environmental exposure were evaluated on elastomers, structural plastics, lubricants, propellants, ablative materials, valves, regulators, actuators, bearings, and other items. The effects of simulated micrometeoroid impact on structural materials and propellant tank insulations were evaluated. Advanced methods of suspension and insulation for space storability of cryogenic propellants were devised and tested on a 3-ft-diam., thermally accurate model of a spherical propellant tank. A lightweight space experiment to utilize excess payload capacity of future satellite vehicles, to perform experiments confirming and extending the micrometeoroid flux and impact data obtained under this program was designed. Author

N63-21044 IIT Research Inst., Chicago, Ill.
STUDIES OF LUNAR SOIL MECHANICS Final Report
E. Vey and J. D. Nelson July 1963 100 p 57 refs
(NASA Contract NASr-65(02)
(NASA CR-50930) OTS: $8.60 ph, $3.20 mf

To provide basic engineering data on the behavior of soils under lunar environmental conditions, experiments were performed to determine the properties of soils under atmospheric pressures and vacuum levels up to the 10^{-10} torr range. Experiments consisted primarily of the determination of the vacuum in soil pores in relation to chamber vacuum, the porosity attained by deposited soil, shear-strength parameters, and load-settlement relationships on small loaded areas. It was observed that the vacuum in the soil pores was considerably less than that recorded in the chamber. Porosities attained by soil deposited under low vacuums (1 to 10^{-3} torr) were less than those attained in atmosphere. But at higher vacuum levels the porosity increased with an increase in vacuum, and in the case of silica flour, for vacuums of 10^{-7} torr or higher, it was greater than when deposited in atmosphere. Direct shear tests showed that the apparent cohesion and the internal friction of the silica flour increased under vacuum. This was also evidenced by increased bearing capacity. The increase in porosity in soils, and the effects on the apparent cohesion, were attributed to the development of interparticle forces. These forces may be either attractive or repulsive depending on the mineralogical composition of the soil and the vacuum level. Author

N63-21049 Stanford Research Inst., Menlo Park, Calif.
SPACE ENVIRONMENT EFFECTS ON POLYMERIC MATERIALS Interim Technical Report No. 1, Oct. 1962-June 1963
D. L. Chamberlain et al June 8, 1963 43 p
(NASA Contract NAS7-100; JPL Contract 950324; SRI Proj. PLU-4257)
(NASA CR-50952) OTS: $4.60 ph, $1.49 mf

Work was conducted to provide a definitive study of the effect of high vacuum (pressures greater than 10^{-8}mm of mercury) and temperatures in the range of 400° to 550° K on polymeric materials which are suitable for use in spacecraft. Included were studies of (1) polymer degradation by mass spectrometry, (2) volatile condensable materials, and (3) polymer syntheses and degradation. Materials under study include laboratory-prepared polymers and commercial polymers, such as teflons, vitons, mylars, polyamides, and silicone rubbers. C.L.W.

N63-21051 National Aeronautics and Space Administration, Washington, D.C.
WHY SPACE?
Homer E. Newell Apr. 6, 1962 26 p Presented at Ann. Meeting of the Am. Soc. for Eng. Educ. at Tex. Tech. Coll., Lubbock
(NASA TM X-50290) OTS: $2.60 ph, $0.98 mf

The importance of the U.S. space program in terms of science, exploration, technological developments, and applications to human welfare is discussed. It is believed that this program will yield full returns on every dollar expended in the form of knowledge; advanced technology; applications to human welfare; meteorology; communications and navigation; contributions to our military strength; benefits to education, industry, commerce, and agriculture; stimulation of our economy; and the development of profitable international ties through mutual cooperation in space activities. C.L.W.

N63-21064 Yale U. Observatory, New Haven, Conn.
PRESENCE AND CORRELATION OF FINE STRUCTURE IN JOVIAN DECAMETRIC RADIATION
James N. Douglas and Harlan J. Smith Repr. from Nature, v. 192, no.4804, Nov. 25, 1961 p 741 11 refs
(NASA Grant NsG-73-60)

The presence and correlation of fine structure in Jovian decametric radiation was accomplished by a series of baseline correlation observations using four identical crystal-controlled total-power receivers working at 22.200 mc/s with 6-kc/s bandwidth fed with identical antennas. Records obtained on 19 nights exhibited various degrees of correlation, including 6 nights on which correlation was essentially perfect, without amplitude distortion. It is concluded that fine structure is characteristic either of the source at Jupiter or of the interplanetary medium, but that this intrinsic structure is often largely obliterated by local ionospheric effects. P.V.E.

N63-21099 National Aeronautics and Space Administration, Goddard Inst. for Space Studies, New York, N.Y.
THE STRUCTURE OF STARS OF VERY LOW MASS
Shiv. S. Kumar (Natl. Acad. of Sci.) Repr. from Astrophys. J., v. 137, no. 4, May 15, 1963 p 1121-1125 3 refs Previously announced as a preprint, see X63-11060 06-05
(NASA RP-13)

Completely convective models have been constructed for stars of masses 0.09, 0.08, 0.07, 0.06, 0.05, and 0.04 (solar units), taking into account the nonrelativistic degeneracy of the stellar material. It is shown that there is a lower limit to the mass of a main-sequence star. The stars with mass less than this limit become completely degenerate stars, or black dwarfs, as a consequence of gravitational contraction, and never go through the normal stellar evolution. Author

N63-21100 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EARTH ALBEDO INPUT TO FLAT PLATES
F. G. Cunningham Repr. from AIAA J., v. 1, no. 6, June 1963 p 1434-1436 3 refs
(NASA RP-16)

The results of an analysis considering the earth's reflected solar radiation incident upon a spinning flat plate are presented briefly. A general description of the problem is given, as well as a definition of all of the geometrical parameters, even though the final result itself is not given explicitly. The final integral expression is given, as well as the expressions for determining the integration limits. In actual practice, it is easy to perform the integration with the aid of a computer. The parameters introduced succeed in defining the orientation of the surface with respect to the earth. Author

N63-21111 General Mills, Inc., Minneapolis, Minn. Electronics Div.
INVESTIGATION OF SPUTTERING EFFECTS ON THE MOON'S SURFACE First Quarterly Status Report, 25 Apr.-24 July 1963
G. K. Wehner, D. L. Rosenberg, and C. E. Ken Knight July 31, 1963 22 p 11 refs
(NASA Contracts NASw-751 and NASw 424; Proj. 8930)
(NASA CR-51082; Rept. 2414) OTS: $2.60 ph, $0.86 mf

Long-duration, solar-wind sputtering conditions were simulated at at a much accelerated scale with mass-separated hydrogen-ion beams, or in low-pressure, noble-gas or hydrogen plasmas. Experiments with metal targets and metal-oxide-, and rock-powder samples demonstrate the leveling and smoothing of macroscopic surface features, and cementing together of loose particles into a porous, brittle, fibrous crust. Certain oxide surfaces become enriched with metal atoms under the bombardment and sputtering action. It is concluded that many of the unusual properties of the lunar surface can be explained by the action of solar-wind bombardment. Author

N63-21130 National Aeronautics and Space Administration, Washington, D.C.
MANNED SPACE FLIGHT PROGRAM
Joseph F. Shea *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6–9, 1963 p 37–45 (See N63-21126 21-01)

The manned spaceflight projects are summarized, with emphasis being placed on the steps leading to manned lunar landing. Included are: the Mercury one-day flight of May, 1963; the Gemini flights—unmanned, long-duration, and rendezvous and docking phases extending into early 1965; and the Apollo flights—module qualification, manned earth orbital, rendezvous and docking, manned circumlunar, lunar orbital, and lunar landing—projected into 1967 or 1970. D.E.R.

N63-21273 National Aeronautics and Space Administration, Washington, D.C.
THE MISSION OF MAN IN SPACE
Homer E. Newell Washington, U.S. Govt. Print. Off., 1963 18 p Pamphlet
(NASA AL-C-4-63) GPO: $0.15

A discussion is presented of the mission of man in space. Topics discussed include: effectiveness and usefulness of unmanned satellites, necessity of man in space, scientific exploration, man on and around the moon, and man in interplanetary space and on the planets. P.V.E.

N63-21328 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MOON-TO-EARTH TRAJECTORIES
S. S. Dallas and T. W. Hamilton June 1, 1963 52 p 6 refs
(NASA Contract NAS7-100)
(NASA CR-50957; JPL-TR-32-412) OTS: $5.60 ph, $1.76 mf

The design and characteristics of trajectories that initiate on the surface of the moon and terminate at a specific landing site on the surface of the earth are presented in this report, along with computing techniques for such trajectories. Results from an analytic trajectory-computing program are used for the qualitative discussions, and results from a precision integrating program are used for the quantitative discussions. Author

N63-21331 North American Aviation, Inc., Downey, Calif.
OPTIMUM TWO-IMPULSE ORBITAL TRANSFER AND RENDEZVOUS BETWEEN INCLINED ELLIPTICAL ORBITS
Gary Mc Cue N.Y., Am. Inst. of Aeron. and Astronautics [1963] 11 p 9 refs Presented at the AIAA Astrodyn. Conf., Yale U., New Haven, Aug. 19–21, 1963
(NASA Contract NAS8-1582)
(AIAA Paper 63423) AIAA: $0.50 members, $1.00 nonmembers

Mathematical formulations of the general (inclined orbits and free end points) optimum two-impulse orbital-transfer problem lead to expressions which, except for special cases, are analytically intractable. Numerical techniques were developed and used to study optimum transfer modes. A parameter space was adopted to represent the impulse function; that is, impulse is a function of takeoff point, arrival point, and transfer orbit semilatus rectum. This abstraction allowed visualization and detailed examination of surfaces of constant impulse, thus revealing the structure of the impulse function. As a result of this study, one may predict the gross properties of impulse-function spaces and consequently determine the optimum two-impulse orbital-transfer circumstances for any pair of elliptical orbits. The method is easily extended to computation of time constraints for two-impulse rendezvous. Author

N63-21337 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-VENUS TRAJECTORIES, 1967, VOLUME 3, PART A
V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, C. G. Pfeiffer June 15, 1963 790 p 9 refs
(NASA Contract NAS7-100)
(NASA CR-50991; JPL-TM-33-99, Vol. 3, Pt. A) OTS: $31.00 ph, $23.90 mf

This report presents the results of extensive machine computations of three-dimensional ballistic interplanetary trajectories. The analytic model used to represent these trajectories is based upon two-body, inverse-square, force field mechanics. A brief explanation of the model is presented. Basically, the trajectories are calculated in two distinct parts: (1) the heliocentric transfer ellipse, and (2) the launch-planet-centered escape trajectories. Following these trajectories, differential corrections or error coefficients and guidance and tracking parameters are given. Author

N63-21338 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-VENUS TRAJECTORIES, 1967, VOLUME 3, PART B
V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer July 1, 1963 789 p 9 refs For abstract see N63-21337 21-29
(NASA Contract NAS7-100)
(NASA CR-51010; JPL-TM-33-99) OTS: $31.00 ph, $23.87 mf

N63-21339 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-VENUS TRAJECTORIES, 1967, VOLUME 3, PART C
V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer July 15, 1963 792 p 9 refs For abstract see N63-21337 21-29
(NASA Contract NAS7-100)
(NASA CR-51329; JPL-TM-33-99, Vol. 3, Pt. C) OTS: $31.00 ph, $23.96 mf

N63-21344 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A CONTRIBUTION TO THE THEORY OF CRITICAL INCLINATION OF CLOSE EARTH SATELLITES
Shinko Aoki Sept. 1963 34 p 13 refs
(NASA TN D-1858) OTS: $1.00

A higher order theory of the motion of close satellites in the vicinity of the critical inclination is developed for the case of small eccentricity as well as moderate eccentricity. Terms up to the third order of magnitude are included for a potential which is plane symmetrical. It is shown that solutions up to this order can be obtained by using only Jacobian elliptic functions for the case of small eccentricity. For moderate eccentricity, elliptic integrals of the second kind or the Jacobian zeta-function are required. To obtain further approximations, elliptic integrals of the third kind are necessary for the case of small eccentricity; but, for the case of moderate eccentricity, only the Jacobian elliptic functions and elliptic integrals of the second kind are required. The solutions are, in general, periodic functions, as is well known from the form of the equations of motion. Author

N63-21346 Virginia Polytechnic Inst., Blacksburg
LUNAR EXPLORATION. PROCEEDINGS OF THE CONFERENCE ON LUNAR EXPLORATION, PART C – AUGUST 12-17, 1962

Oran W. Nicks et al Aug. 1962 169 p 52 refs Repr. from Bull. Eng. Expt. Sta., v. 56, no. 7, May 1963
(Supported by NASA and NSF)
(*Its* Eng. Expt. Stat. Series 152)

The following topics dealing with lunar exploration were discussed: (1) photography of the moon from space probes, (2) lunar seismology, (3) prospects for the existence of lunar organic matter, (4) instrumentation for lunar soft landings and (5) the nature of the lunar surface and major structural features. P.V.E.

30 SPACE VEHICLES

Includes: launch vehicle—spacecraft combinations; operating problems; and stability and control.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For related information see: 04 Aircraft; 08 Communication; and 22 Navigation and Guidance.

N63-21031 General Dynamics/Astronautics, San Diego, Calif.
RELIABILITY IMPROVEMENT PROGRAM PLAN FOR STANDARD SPACE LAUNCH VEHICLE (SLV-3)
June 20, 1963 75 p
(Contract AF 04(694)-240)
(GDA-63-0436; formerly publ. as AOL-62-0026)

This document specifies the general requirements for reliability and quality assurance to be used during the development, manufacture, test, and operation of the Atlas Space Launch Vehicle-3. Requirements for program management and control, test and evaluation, reliability assurance, quality control and inspection, and reporting have been included. P.V.E.

N63-21131 National Aeronautics and Space Administration. Manned Spacecraft Center, Langley Station, Va.
MANNED SPACECRAFT
James C. Elms *In* NASA, Washington, D.C. Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963 p 47-53 (See N63-21126 21-01)

Gemini and Apollo spaceflights are reviewed. The Gemini spaceflight will demonstrate man's ability to live in a weightless environment and to perform the tasks of rendezvousing and docking. The lunar-orbit-rendezvous mode of operation selected for the Apollo mission is discussed in the light of: (1) the launching of the spacecraft mounted atop the advanced SATURN launch vehicle; (2) the performance of the launch vehicle; (3) the Apollo spacecraft which consists of the command module for housing the astronauts; the surface module which contains fuel, supplies, and an engine; and the lunar module which actually lands on the moon; (4) the lunar landing; and (5) the return of the astronauts to earth after twenty-four hours on the moon. I.v.L.

N63-21132 National Aeronautics and Space Administration, Washington, D.C.
LARGE LAUNCH VEHICLES IN THE MANNED SPACE PROGRAM
Robert F. Freitag *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963 p 55-65 (See N63-21126 21-01)

The program underway to provide large boosters for the nation's manned spaceflight program and lunar-landing program is described. Initially manned spaceflight operations will utilize booster vehicles evolved from ICBM vehicles. Typical of these vehicles is the Atlas booster used to place the Mercury spacecraft in orbit. Later, another ICBM, the TITAN, will be adapted as a booster for manned space operations. Much larger than the ATLAS- and TITAN-based carriers are three launch vehicles, the SATURN I, SATURN IB, and SATURN V. These vehicles will be capable of sending payloads of many tons into earth orbit, to the moon, and into deep space. The main purpose of the SATURN project is manned space exploration which includes the landing of men and equipment on the moon within this decade. Studies of other advanced launch vehicles are underway to provide capacities for even greater payloads to the moon or for interplanetary missions. These studies, known as Nova studies, are in an advanced state. Also discussed are launch-vehicle facilities. I.v.L.

N63-21316 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOOK AT THE REENTRY PROBLEM
Donald L. Baradell N.Y., Am. Inst. of Aeron. and Astronautics [1963] 14 p 72 refs Presented at the AIAA Guidance Control Conf., Mass. Inst. of Tech., Cambridge, Aug. 12-14, 1963 (AIAA Paper 63-318) AIAA: $0.50 members, $1.00 nonmembers

The development of the reentry problems to date and future problem areas which will affect reentry guidance and control requirements are discussed. The earth reentry picture is summarized as follows: Reentry from near-earth orbits can be accomplished by simple vehicles performing simple maneuvers. For reentry at near-escape velocity, vehicles with some lift capability are required, but simple reentry techniques are still satisfactory. Reentry at velocities considerably in excess of escape velocity will require refined vehicles performing complex maneuvers in order that reasonable corridor widths might be obtained. P.V.E.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-20759 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN RADAR ALTIMETER
O. T. Dugan N.Y., Am. Inst. of Aeron. and Astronautics [1963] 7 p 2 refs Presented at the AIAA Guidance and Control Conf., Cambridge, Mass., Aug. 12-14, 1963
(AIAA Paper 63-352) AIAA: $0.50 members, $1.00 nonmembers

A high-altitude radar altimeter designed for use on the Saturn vehicle is described. Operational characteristics of the altimeter were dictated by the mission it was to perform. It was designed to operate at altitudes between 50 km and 400 km over water, and to supply altitude information in data increments of less than 8 meters with an accuracy of ±30 meters. Altitude readings were required at a rate of no

less than 10 per second to be telemetered or recorded on tape for playback on command. System operation and subassembly operations are presented with emphasis on the automatic tracking circuits and the data-transmission system. Problems associated with the design of the altimeter, and the results of the first experimental flight on Saturn vehicle SA-4, are discussed. Author

N63-20885 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROPERTIES OF MATERIALS
Henry E. Frankel *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 1962 28 p 8 refs (See N63-20876 21-33)

The selection of materials for space applications is surveyed. Material selection criteria are discussed in general; then the material requirements for survival of a spacecraft in the space environment are contrasted to those associated with a launch vehicle. The effect of fabrication techniques, such as welding, on the initial properties of the material is assessed. A list of materials that are permitted at present for major Goddard spacecraft is included. M.P.G.

N63-20937 Radio Corp. of America, Burlington, Mass. Aerospace Communications and Controls Div.
OPERATIONAL FLIGHT CONTROL FOR SATURN BOOST VEHICLES
C. W. Steeg, Jr., M. Pesando, and G. Filias N.Y., Inst. of the Aerospace Sci. [1963] 24 p 3 refs Presented at the IAS 31st Ann. Meeting, N.Y., Jan. 21–23, 1963
(Supported by NASA and Air Force)
(IAS Paper-63-42) IAS: $0.50 members, $1.00 nonmembers

The Operational Flight Control (OFC) is a real-time control system which is applicable to monitoring and assessing Saturn vehicle performance and capability during powered flight, and for adjusting inflight parameters to compensate for subsystem malfunctions or unforeseen circumstances is discussed. System concepts, system approach, concept feasibility, and system design configuration are presented. Onboard and ground systems are combined by the OFC concept for maximum overall effectiveness. C.L.W.

32 SPACE VEHICLES (SPACECRAFT)

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For Launch vehicle—spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-20740 Aerospace Information Div., Library of Congress, Washington, D.C.
CUMULATIVE DATA ON VOSTOK FLIGHTS. A.I.D. PRESS: VOLUME 2, No. 44
Aug. 29, 1963 7 p 33 refs
OTS: $1.10 ph, $0.80 mf

A compilation of data from Soviet open literature on the Vostok series of spaceflights is presented. The tabulated data for Vostoks 1 through 6 include pilot rank and birthdate, call sign, launch time and site, spacecraft weight, orbital elements, communications frequencies, pulse rate and respiration, cabin temperature, pressure and relative humidity, flight duration, orbital passes, distance traveled, landing option, landing time, and landing point. M.P.G.

N63-20756 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THEORETICAL AND PRACTICAL ASPECTS OF SOLAR PRESSURE ATTITUDE CONTROL FOR INTERPLANETARY SPACECRAFT
James D. Acord and John C. Nicklas N.Y., Am. Inst. of Aeron. and Astronautics [1963] 12 p 7 refs Presented at the AIAA Guidance and Control Conf., Cambridge, Mass., Aug. 12–14, 1963
(NASA Contract NAS7-100)
(AIAA Paper 63-327) AIAA: $0.50 members, $1.00 nonmembers

This paper briefly covers the theory of photon momentum transfer to the exposed surfaces and gives an engineering derivation of the essential equations and parameters for dealing with the resulting forces in a practical manner. Various configurations of spacecraft equipment and control surfaces are examined as to magnitudes and directions of solar pressure torques and the necessary conditions for control. Some of the major system integration considerations are discussed, with particular emphasis on a minimum-interface combination of the solar pressure control system with an impulsive mass-expulsion system. Some of the special considerations and peculiarities involved in mechanizing such a low torque, low response, control system are discussed. Author

N63-20772 Applied Physics Lab., Silver Spring, Md.
A SYSTEM FOR PASSIVE GRAVITY-GRADIENT STABILIZATION OF EARTH SATELLITES
Rorert E. Fischell and Frederick F. Mobley Aug. 1963 57 p 15 refs
(Contract NOw 62-0604-c)
(TG-514)

Gravity-gradient attitude stabilization of a satellite is defined herein as the alignment of one axis of the satellite along the earth's local vertical direction so that a particular end of the satellite always faces in the downward direction. Passive gravity-gradient stabilization is defined as achieving this orientation, including damping the resulting librations, without the use of active control elements such as servo systems, reaction wheels, or gas jets. The theory of gravity-gradient attitude stabilization is outlined and the procedures for achieving stabilization are given. A yoyo device and an electromagnet, which is attached rigidly to the satellite, are used to remove the spin of the satellite and to align it vertically, with the correct side facing downward. The tumbling rate of the satellite is decreased, and through the force of a gravity-gradient torque acting upon it, the satellite will achieve a tumbling rate equal in magnitude to that which is needed to stabilize it vertically. C.L.W.

N63-20816 General Electric Co., Evendale, Ohio. Missile and Space Div.
VENUS-MARS CAPSULE STUDY, VOLUME I (REVISED)
Mar. 1, 1963 598 p refs
(NASA Contract NAS7-100; Contract JPL-950250)
(NASA CR-50956) OTS: $26.00 ph, $18.14 mf

A study was conducted to determine the feasibility of sending capsules on impact trajectories to Venus and have them transmit to the Earth information about the thermodynamic variations of the planet atmosphere, to investigate and establish the primary controlling parameters as they affect the performance and capability of a capsule design, and to relate

the capsule requirements and capabilities to future Venus and Mars capsule missions. The results of the study indicate that it is feasible to design a capsule that will survive entry and collect and transmit data to the Earth as to the characteristics of the Venusian atmosphere. The difference in the design of capsules for Mars and Venus was also discussed. It was indicated that the heat shield for the Venus capsule may be twice as heavy as the heat shield for the Mars capsule. The Mars capsule will require a parachute retardation system in order to obtain adequate subsonic descent times whereas the Venus capsule obtain roughly the same descent times without the use of a retardation system. These differences in the two capsules tend to balance out on a weight basis yielding capsules with roughly the same payload capability for the same total weight. C.L.W.

N63-20838 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
A SUGGESTED DESIGN FOR A SATELLITE FOR STELLAR ULTRA-VIOLET SPECTROMETRY
A. G. Earl, G. W. Stark, H. J. H. Sketch, G. W. Brown, and G. C. Sudbury London, Min. of Aviation Mar. 1963 65 p 34 refs
(RAE-R-SPACE-1)

The requirements of a satellite to be used for measuring the ultraviolet spectra of selected stars are discussed. Possible solutions to the design problems are outlined, and a detailed description is given of the design considered to be the most promising. Author

N63-20938 Hughes Aircraft Co., Culver City, Calif.
A SYNCOM SATELLITE PROGRAM
C. Gordon Murphy N.Y., Am. Inst. of Aeron. and Astronautics [1963] 22 p Presented at the AIAA Summer Meeting, Los Angeles, June 17-20, 1963
(AIAA Paper 63-264) AIAA: $0.50 members, $1.00 nonmembers

The Syncom satellites are designed for deployment in circular synchronous orbits. They are launched toward the synchronous altitude on an elliptical transfer orbit from a circular parking orbit. The launch vehicle imparts spin to the spacecraft and establishes the initial orientation of the spin axis prior to separating from the spacecraft. Rocket control systems which can be fired in either a pulsed or a continuous mode are used to change the spin-axis orientation and to provide the orbit control of the spacecraft in the synchronous orbit. The first flight of Syncom I is described, including telemetry data and communications experiments. Proposed changes for the second flight are outlined. E.K.R.

N63-20962 Aeronutronic, Newport Beach, Calif.
LUNAR ROUGH LANDING CAPSULE DEVELOPMENT Final Technical Report
Feb. 20, 1963 249 p 23 refs
(NASA Contract NAS7-100; JPL Contract N-21453)
(NASA CR-51022; U-2007) OTS: $16.00 ph, $7.67 mf

The program for development of a lunar capsule for conducting an extended seismometer experiment on the moon is discussed. The program's basic approach was divided into the following phases: (1) providing a retrorocket to remove the bulk of the approach velocity, (2) using a passive impact limiter to absorb the energy remaining at lunar impact, and (3) designing the experiment package to be capable of surviving the resultant environments. P.V.E.

N63-20998 Aeronutronic, Newport Beach, Calif.
THE SPADATS MATHEMATICAL MODEL Technical Documentary Report
C. Geoffrey Hilton Aug. 5, 1963 50 p 3 refs
(Contract AF 19(628)-562)
(U-2202; ESD-TDR-63-427)

The mathematical model presently used by the Space Detection and Tracking System (SPADATS), to describe the orbital motion of earth satellites is presented. The formulation is given, and the non-Keplerian terms are justified. Various output formats of the system are described and defined. Limitations of the model are discussed in a qualitative fashion. Author

N63-21056 National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EFFECTS OF PEAK DECELERATION ON RANGE SENSITIVITY FOR A MODULATED-LIFT REENTRY AT SUPERCIRCULARS SPEEDS
Charlie M. Jackson, Jr., and Roy V. Harris, Jr. Washington, NASA, Sept. 1963 26 p 5 refs
(NASA TN D-1955) OTS: $0.75

Existing techniques were used to compute the flight path parameters for a maneuver which would define the undershoot boundary of the reentry corridor. Reentry conditions considered were velocities of 34,000, 36,000, and 38,000 fps and flightpath angles of $-6°$, $-7°$, $-8°$, $-10°$, and $-12°$. The effects of variation of peak deceleration on range and energy level of the vehicle at the end of the pullup maneuver were investigated, and the results indicated a high degree of sensitivity of these parameters to peak-deceleration variations when minimum peak deceleration was maintained. Author

N63-21101 Martin Co., Baltimore, Md. Space Systems Div.
SPACE FLIGHT HANDBOOKS. VOLUME I: ORBITAL FLIGHT HANDBOOK; PART I – BASIC TECHNIQUES AND DATA
George Townsend and Donald Kraft et al Washington, NASA, Office of Sci. and Tech. Inform. 1963 323 p refs
(NASA Contract NAS8-5031)
(NASA-SP-33; Pt.1) OTS: $5.00

A presentation is given of background data and material for developing basic techniques and data for earth orbital missions. Subjects discussed in this volume include: (1) physical data—presentation of a set of constants necessary in the computation of trajectories; (2) orbital mechanics—presentation of basic central motion trajectory equations; and (3) perturbations—special and general perturbation techniques. P.V.E.

N63-21102 Martin Co., Baltimore, Md. Space System Div.
SPACE FLIGHT HANDBOOKS. VOLUME I: ORBITAL FLIGHT HANDBOOK; PART 2 – MISSION SEQUENCING PROBLEMS
George Townsend and Donald Kraft et al Washington, NASA, Office of Sci. and Tech. Inform., 1963 443 p refs
(NASA Contract NAS8-5031)
(NASA-SP-33, Pt. 2) OTS: $6.00

An orbital flight handbook is presented which is concerned with earth orbital missions. Included are some of the various calculations and corrections which are encountered in analyses of orbit maneuvers, rendezvous, orbital departure, and satellite reentry. C.L.W.

N63-21103 Martin Co., Baltimore, Md. Space Systems Div.
SPACE FLIGHT HANDBOOKS. VOLUME I: ORBITAL FLIGHT HANDBOOK; PART 3 – REQUIREMENTS

George Townsend and Donald Kraft et al Washington, NASA. Office of Sci. and Tech. Inform., 1963 384 p refs
(NASA Contract NAS8-5031)
(NASA-SP-33, Pt. 3) OTS: $5.00

A presentation is given of background data and material to be used in determining the requirements for earth orbital missions. The following are discussed in this volume: (1) waiting-orbit criteria, (2) orbit computations, (3) guidance and control requirements, and (4) mission requirements.
P.V.E.

N63-21104 Martin Co., Baltimore, Md. Space Systems Div.
SPACE FLIGHT HANDBOOKS. VOLUME 2: LUNAR FLIGHT HANDBOOK; PART 1 — BACKGROUND MATERIAL
Fred Martikan and Frank Santora et al Washington, NASA. Office of Sci. and Tech. Inform., 1963 143 p refs
(NASA Contract NAS8-5031)
(NASA-SP-34, Pt. 1) OTS: $2.75

Background information on the flight mechanics aspects of lunar missions is presented. The astronautical constants describing the gravitational force acting on the space vehicle and the geometry of the celestial bodies are discussed, and the atmospheric, meteoric, radiative and thermal environment, and its effects on a space vehicle and its occupants are considered. The motion of a space vehicle in earth-moon space as interpreted in the three-body and restricted three-body problems of astronomy is discussed. The force models for trajectory calculation are described, and lunar trajectories and missions are classified.
M.P.G.

N63-21105 Martin Co., Baltimore, Md. Space Systems Div.
SPACE FLIGHT HANDBOOKS. VOLUME 2: LUNAR FLIGHT HANDBOOK; PART 2 — LUNAR MISSION PHASES
Fred Martikan and Frank Santora et al Washington, NASA. Office of Sci. and Tech. Inform., 1963 444 p refs
(NASA Contract NAS8-5031)
(NASA-SP-34, Pt. 2) OTS: $6.00

Detailed trajectory data for the various phases of a lunar mission are presented. Earth departure, earth-to-moon transfer, lunar orbit, descent to and ascent from the lunar surface, moon-to-earth transfer, and earth return trajectory techniques are discussed. A major portion of circumlunar and lunar approach and return trajectories are cataloged to a high degree of accuracy using the Voice (volume of influence calculated envelopes) technique.
M.P.G.

N63-21106 Martin Co., Baltimore, Md. Space Systems Div.
SPACE FLIGHT HANDBOOKS. VOLUME 2: LUNAR FLIGHT HANDBOOK; PART 3 — MISSION PLANNING
Fred Martikan and Frank Santora et al Washington, NASA. Office of Sci. and Tech. Inform., 1963 156 p refs
(NASA Contract NAS8-5031)
(NASA-SP-34, Pt. 3) OTS: $3.00

Methods of interpreting the general lunar trajectory data and using this data for specific mission dates are discussed. Equations for converting the selenographic coordinates of a particular lunar site or area relative to the moon's polar plane (MOP) and the moon-earth line ($\overline{MEL}$) are presented. The lunar terminator is defined, and equations giving the orientation of the terminator in both the selenographic and MOP-$\overline{MEL}$ coordinate systems are presented. Declination, radial distance, and moon phase data for 1963 to 1971 are tabulated, and the conversion between generalized trajectory data and specific mission dates is demonstrated. Empirical equations that extend the cataloged data to other injection altitudes and flight path angles are included, as well as energy requirements for controlling return flight time and changing the trans-earth trajectory inclination. Mission planning envelopes (generalized geometrical relationships for a given set of mission constraints) are charted for both the circumlunar and approach class trajectories. The procedures and steps to be followed in evaluating specific missions are demonstrated using a manned lunar landing and return mission, and an unmanned photoreconnaissance mission as examples.
M.P.G.

N63-21127 National Aeronautics and Space Administration, Washington, D.C.
THE NATIONAL PROGRAM FOR THE EXPLORATION OF SPACE
De Marquis D. Wyatt *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963 p 9-17 (See N63-21126 21-01)

The three major parts of the program are: (1) the exploration of the nature of space, (2) the early utilization of space for the benefit of man, and (3) the development of our technology to meet the problems to be confronted in space. The many types of satellites and sounding rockets used to accomplish each of these goals, and the scientific accomplishments of each are then summarized. The United States present position in the field of space exploration is outlined.
D.E.R.

N63-21128 National Aeronautics and Space Administration, Washington, D.C.
RESULTS OF SCIENTIFIC RESEARCH IN SPACE
John E. Naugle *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963 p 19-26 (See N63-21126 21-01)

The six scientific satellites launched by NASA in 1962 are described, and it is found that small explorer and monitor satellites can be launched with a high degree of success. The performance of the OSO I leads to the possibility of complex spacecraft in the near future.
D.E.R.

N63-21129 National Aeronautics and Space Administration, Washington, D.C.
SPACE SCIENCES — LUNAR AND PLANETARY EXPLORATION
Oran W. Nicks *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963 p 27-36 (See N63-21126 21-01)

The unmanned lunar and planetary exploratory projects now in progress and planned in the near future are outlined. Included are: the Ranger, Voyager, and Mariner projects; missions to Mars and Venus; a probe of the Sun to about 1/3 astronomical unit; and other missions—to the outer planets, out of the plane of ecliptic, comets, asteroids, and escape from the solar system.
D.E.R.

N63-21136 National Aeronautics and Space Administration, Washington, D.C.
SCIENTIFIC SPACECRAFT
Edgar M. Cortright *In its* Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963 p 95-99 (See N63-21126 21-01)

Unmanned instrumented spacecraft for exploring the solar system are reviewed. The Atmospheric Structure Satellite has already been successfully launched. An advanced Orbiting Geophysical Observatory will be launched in 1964. This satellite is designed to obtain simultaneous measurements of a large number of geophysical and solar phenomena. A Mariner spacecraft designed to fly to Mars will be launched in 1964.

Stabilizing vanes are being added to the tips of the solar panels to both back up and conserve the gas used to control this spacecraft. These vanes use solar pressure for control. The Surveyor is a 750-pound spacecraft designed to soft-land about 115 pounds of scientific and engineering instruments on the moon in 1965. Inasmuch as the Surveyor's solid-propellant retrorocket, used to slow it down at the moon, weighs about 1,350 pounds, the all-up weight will initially be about 2,100 pounds. This weight requires the new Atlas-Centaur launch vehicle. I.v.L.

N63-21250 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOL. 3, NO. 14
July 15, 1963 19 p
(NASA TMX-50372; NASA X-533-63-1) OTS: $1.60 ph, $0.80 mf

A summary of objects in orbit and objects whose orbits have decayed is presented. Information given includes: object name, code name, source (US or USSR), launch date, nodal period, inclination, apogee, perigee, transmitting frequency (MC/S), and decay date. P.V.E.

N63-21323 RAND Corp., Santa Monica, Calif.
SATELLITE LIFETIMES IN NEARLY CIRCULAR ORBITS FOR VARIOUS EARTH-ATMOSPHERE MODELS
L. N. Rowell Aug. 1963 39 p 2 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3700-PR)

This memorandum investigates the effects on earth-satellite life-times of altitude, orbit-plane inclination, and perturbation forces for close-in, nearly circular orbits. The lifetimes of two large, heavy satellites were studied. Studies of orbits with initial altitudes of from 75 to 150 nmi show that satellite lifetime increases significantly as the orbit-plane inclination increases toward 90 deg, and that the ratio of change in lifetime to change in orbit-plane inclination increases as the orbital altitude increases. Satellite lifetimes based on an oblate atmosphere model are significantly greater than those based on a spherical atmosphere model for nonequatorial satellites. The combined gravitational attractions of the moon and sun cause only negligible variations in the lifetimes of the satellites studied. Author

N63-21336 National Aeronautics and Space Administration, Washington, D.C.
METEOROLOGICAL SATELLITES
Morris Tepper [1963] 20 p Based on a Paper presented at the Second Natl. Conf. on Peaceful Uses of Space, Seattle, Wash., May 1962
(NASA AL-D 4-63) GPO: $0.15

The accomplishments of the six Tiros meteorological satellites are summarized, and the immediate objectives established for improving the capabilities of future meteorological satellite systems are reviewed. The accomplishments noted include: (1) demonstration of the feasibility of a meteorological satellite as an engineering system; (2) measurement of important scientific aspects of the atmosphere; (3) actual use of satellite measurements in day-to-day weather analysis and forecasting; (4) initiation of an active international program of scientific cooperation in meteorological satellites; and (5) establishment of a National Operational Meteorological Satellite System to provide satellite data on a regular basis for the use of weather services. The steps which have been taken to implement the six immediate goals of improved capability are reviewed; these goals are: (1) to improve the satellite itself as an observation platform; (2) to increase the observational area coverage of the satellite; (3) to increase the frequency of observations of an individual area; (4) to continue the development of new flight sensory systems; (5) to continue to provide data from meteorological satellites in orbit for real-time use by the forecaster; and (6) to continue to engage in international programs. M.P.G.

N63-21341 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
GROUND EQUIPMENT TO SUPPORT THE SATURN VEHICLE
Georg Von Tiesenhausen N.Y., Am Rocket Soc., Dec. 8 1960 16 p Presented at the ARS, 15th Annual Meeting, Washington, D.C., Dec. 5–8, 1960
(ARS Paper 1425-60) $0.50 members; $1.00 nonmembers

With the advent of the first large space vehicle, the Saturn, the ground-support-equipment and launch-facility designer is faced with the necessity of conceiving and building an unprecedented launch system concurrent with the vehicle development. This paper follows the Saturn through the various modes of operation, such as transportation over land and water, checkout, handling and erection, propellant loading, and describes the facilities at the launch site. Author

N63-21345 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF THE DYNAMIC TESTS OF THE STRETCH YO-YO DE-SPIN SYSTEM
William R. Mentzer Washington, NASA, Sept. 1963 25 p 3 refs
(NASA TN D-1902) OTS: $0.75

Results of the stretch yo-yo feasibility and flight qualification tests are presented. These tests were conducted to prove the concept that the stretch yo-yo is a more accurate despin device than the rigid yo-yo, and to verify the analytical development of the stretch yo-yo properties. Variations in the design parameters and their effects on the final spin rate of the payload are noted in the analysis of the test results. The variables include initial spin rate, moment of inertia, and spring properties. A computer solution of the test payload equations of motion is included for comparison with the experimental results to confirm the mathematical analysis of the stretch yo-yo system. As a result of the successful flight qualification tests, a stretch yo-yo was flown on Ariel I. Author

N63-21348 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE ELECTRIC SPACE CRUISER FOR HIGH-ENERGY MISSIONS
Robert J. Beale, Evelyn W. Speiser, and James R. Womack June 8, 1963 21 p 8 refs
(NASA Contract NAS7-100)
(NASA CR-51015; JPL-TR-32-404) OTS: $2.60 ph, $0.63 mf

A basic spacecraft capable of significant, unmanned exploration of the entire solar system can be achieved by the use of a modest nuclear–electric propulsion system employing a *Saturn* 1-*B* booster chain. Basic system requirements for this type of vehicle are thrust devices efficient in the specific impulse range of 6000 to 12,000 sec, a nuclear turbo-electric powerplant of 500 kwe, weighing about 14 lb/kw, and a total spacecraft weight of 20,000 lb. A brief systems description of the spacecraft is presented. For discussion purposes, a Jupiter orbiter mission is used as an example. The modes of operation for the spacecraft are reviewed, and a summary of major subsystem weights is shown. Author

33 STRESSES AND LOADS

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

N63-20703 Syracuse U., N.Y.

THE EFFECT OF STRESS CONCENTRATION ON THE FRACTURE AND DEFORMATION CHARACTERISTICS OF CERAMICS AND METALS [Final Report, Dec. 2, 1961-Feb. 1, 1963]

V. Weiss, J. Sessler, K. Grewal, and R. Chait Wright-Patterson AFB, Ohio, Directorate of Mater. and Processes, Apr. 1963 66 p 37 refs

(Contract AF 33(616)-7609)

(ASD-TDR-63-380)

The effects of nonuniform stress distributions on fracture strength were studied on four materials that exhibit brittle behavior: Wesgo AL 995, Mykroy 750 and 1100 (ceramics), and Plexiglas (acrylic plastic). Analysis of the results of both notch tensile and bend tests on these materials indicate that fracture in ceramic materials can be explained by a maximum fracture-stress concept, provided that the inherent nonhomogeneity of these materials is considered in the analysis. Studies of plastic flow in metallic flat notch tensile specimens indicate that the distribution of the principal longitudinal strain across the notch section is related to the distribution of the longitudinal elastic stress raised to the power "b," where "b" is primarily a function of the strain-hardening exponent of the material. Author

N63-20724 Florida U., Gainesville. Engineering and Industrial Experiment Station

RESPONSE OF ELASTIC STRUCTURE TO RANDOM EXCITATIONS OF VARIOUS CORRELATIONS

Marc. R. P. Trubert Aug. 1963 65 p refs

(Grant AF-AFOSR-62-313)

It is possible to determine the response of a linear continuous structure (cantilever beam) to random loadings of various correlations by a semiexperimental method. The mathematical aspect of the problem is stated. The spatial transfer function representing the dynamic characteristics of the structure is determined experimentally by a cross-correlation technique. The response to various correlated loadings is computed, and a comparison is made with the response determined experimentally. The effect of the correlation is noted. Author

N63-20729 Canadian Armament Research and Development Establishment, Valcartier

REVIEW OF HYPERVELOCITY IMPACT THEORIES

P. L. Roney (Computing Devices of Canada, Ltd.) Aug. 1961 38 p 12 refs

(CARDE-TM-623/61) (Declassified)

This review covers the current theories of hypervelocity impact of solid projectiles into homogeneous target materials. The theories are discussed in terms of their correlation with experimental results, and the assumptions associated with the models on which the theories are based are examined and compared. It is found that the theories form into three categories. In the first category, it is assumed that the projectile is not consumed; in the second, the projectile is consumed as in jet penetration. The theories in these two categories deal only with the primary phase of hypervelocity-impact cratering. Bjork's theory, which comes under the third category, where both the primary and secondary phases of impact are considered, has only been applied so far to iron into iron impact. This theory is also limited at present to very high velocities. None of the other theories give complete agreement with experimental data. Author

N63-20746 Southwest Research Inst., San Antonio, Tex.

THE EFFECT OF TRANSIENT CREEP ON THE COLLAPSE TIME OF CYLINDERS AND CONES UNDER EXTERNAL PRESSURE [Final Technical Report, Jan. 22, 1962-Mar. 15, 1963]

E. Z. Stowell and E. M. Briggs Wright-Patterson AFB, Ohio, Aeron. Res. Labs., Aug. 1963 36 p 6 refs

(Contract AF 33(657)-8125)

(ARL-63-132) OTS: $1.00

Previous attempts to compute the collapse time for cylinders under external pressure at elevated temperatures used the assumption of steady-state creep. In many cases the computed collapse times were larger than those indicated by tests. In this work similar computations were made of the collapse time, but including the effect of the transient creep which precedes the onset of the steady state. The inclusion of the transient creep had the effect of reducing the time to collapse in many cases. Comparison of the predicted times with published experimental times for cylinders and cones under various conditions showed that the probable error in prediction was reduced in all cases by the inclusion of transient creep. The most accurate predictions were obtained for the cylinders with fixed ends, for which the collapse time could be determined with a probable error of 28%. Author

N63-20771 Saarland U., Saarbrucken (W. Germany) Inst. for Appl. Mech.

THEORETICAL INVESTIGATIONS OF THE BEHAVIOR OF BRITTLE MATERIALS AT VARIOUS RANGES OF TEMPERATURE [Final Report, Jan. 1, 1962-Dec. 31, 1962]

Udo Wegner Wright-Patterson AFB, Ohio, AF Mater. Lab., July 1963 53 p 6 refs

(Contract AF 61(052)-280)

(ASD-TDR-63-490)

A new theory of elasticity was developed which will provide a mathematical treatment of the behavior of brittle materials. By postulating two axioms concerning the invariance of the deformation energy under any coordinate transformation, and the continuous transition of the volume dilation from the elastic to the plastic range, it was possible to establish a general, invariant, nonlinear stress–strain relation for the three-axial state of stress. This general law of elasticity includes as first approximation the linear Hooke's law. As the theory also has to cover the plastic deformation range, certain known plastic stress–strain relations and work-hardening laws can be obtained as limit cases. To demonstrate the capability of the new theory, some problems of plasticity that are of practical interest are treated. For the extension of the theory to anisotropic media, some group theoretical considerations are performed in order to establish the general form of the deformation energy for these media. Author

N63-20821 United ElectroDynamics, Inc., Pasadena, Calif.

RESEARCH STUDIES OF FREE FIELD INSTRUMENTATION Technical Report [Oct. 1960-Dec. 1962]

J. R. Stagner and R. Obenchain Kirtland AFB, N. Mex., Research Directorate, June 1963 131 p 10 refs

(Contract AF 29(601)-1944)

(AFSWC-TDR-63-45)

The design of a gage capable of measuring free-field stress, strain, and acceleration is reported. Prototypes based on the above design were fabricated and tested in a test tank capable

of producing dynamic pressures up to 800 psi and static pressures up to 1000 psi. The above gages were used to investigate the static and dynamic characteristics of the test tank. Developmental soil gage prototypes and a field system were developed for, and used in, a nuclear field experiment. A description of this field system and test results are given.
Author

N63-20878 Naval Research Lab., Washington, D.C.
VIBRATION FUNDAMENTALS-A
Patrick Cunniff *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 1962 30 p 6 refs (See N63-20876 21-33)

The lumped-parameter approach to analytical representation of a linear elastic structure responding to dynamic forces is described. The single-degree-of-freedom system is treated as the simplest example, followed by a discussion of more complex systems, which require several coordinates to describe their motion. Principle and normal modes of vibration are defined, and the analytical procedures for determining the response of linear elastic structures are reviewed. Influence coefficients, normal modes, orthogonality of normal modes, normal modes as generalized coordinates, and structural response to an applied force, to an impulse, and to steady-state vibrations are represented in the analysis. M.P.G.

N63-20879 Naval Research Lab., Washington, D.C.
VIBRATION FUNDAMENTALS-B
C. Irwin Vigness *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 1962 28 p 15 refs (See N63-20876 21-33)

The response of a complex structure to random stationary vibrations is considered. Random vibrations are defined, and the application of probability concepts to random vibrations is treated. The analysis of random vibrations using a suitable spectrum analyzer with a narrowband filter and the interpretation of the obtained data are explained. The response of single-degree-of-freedom systems to random vibrations is treated to explain the principles involved, followed by examples of determining the response of complex linear systems to random vibration. M.P.G.

N63-20881 General Electric Co., Schenectady, N.Y. General Engineering Lab.
MECHANICAL PROBLEMS
Robert M. Mains *In* Inst. Environ. Sci., Wash., D.C. The Dynamic Environment 1962 23 p 17 refs (See N63-20876 21-33)

Mechanical problems in the dynamic environment are discussed in terms of three principal areas: load definition, response prediction, and damage evaluation. Response prediction methods ranging from direct integration of differential equations through normal modes, impedances, analogs, and models are discussed briefly, with references to more extensive treatments. The end problem of damage evaluation is given considerable attention, since this is the area which is least well defined at present. Author

N63-20887 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENVIRONMENTAL TESTING
William R. Forlifer *In* Inst. of Environ. Sci., Wash., D.C. The Dynamic Environment 27 p 12 refs (See N63-20876 21-33)

Shock and vibration environmental testing of spacecraft and their components is discussed. The purpose of this testing is to ensure, with a high degree of probability, that equipment will survive and operate satisfactorily during the period of its intended use. The establishment of test specifications which envelope the severity of the service environment, the choice of test methods which are conducted according to the intent of the specification, and the factoring of test results back into the design of the equipment are discussed. When the tests are well planned, instrumented, and analyzed, the results are of invaluable assistance to both the test engineer and the designer in evolving a reliable spacecraft system. M.P.G.

N63-20968 Florida U., Gainesville Engineering and Industrial Experiment Station
RESPONSE OF ELASTIC STRUCTURE TO RANDOM EXCITATIONS OF VARIOUS CORRELATIONS
Marc R. P. Trubert Aug. 1963 65 p 17 refs
(Grant AF-AFOSR-62-313)

It is possible to determine the response of a linear continuous structure (cantilever beam) to random loadings of various correlations by a semiexperimental method. The mathematical aspect of the problem is stated. The spatial transfer function representing the dynamic characteristics of the structure is determined experimentally by a cross-correlation technique. The response to various correlated loadings is computed, and a comparison is made with the response determined experimentally. The effect of the correlation is noted.
Author

N63-21030 General Dynamics/Fort Worth, Tex.
STRESS DISTRIBUTION IN BONDED JOINTS
L. R. Lunsford Dec. 31, 1961 37 p 10 refs
(Contract AF 33(657)-11214)
(ERR-FW-130)

Analytical expressions for predicting the strength of bonded joints are derived for the following conditions: (1) joints in which all the load is transferred to the skins through the bondline; (2) joints in which the slug and facing are loaded together in bearing; and (3) joints in which the facing is loaded in bearing by the fastener and in shear transfer through the bondline.
Author

N63-21035 Goodyear Aerospace Corp., Akron, Ohio
STUDY OF THE EFFECTS OF MECHANICAL DAMAGE ON THE PERFORMANCE OF FILAMENT-WOUND MOTOR CASES [Interim Technical] Progress Report No. 2, 1 June-31 July 1963
R. A. Burkley, T. J. Boller, and I. R. Butcher Aug. 20, 1963 18 p
(Contract NOw-63-0449-c(FBM))
(GER 11154A)

This report discusses the fabrication, machine flawing, and testing of six-inch-diameter filament-wound bottles. The objectives of the study program under this contract are to study the effects of surface flaws on the performance of Polaris motor cases, to compare the effect of winding sequence on the ability to resist failure from surface flaws, and to determine the reliability of various repair techniques. Author

N63-21045 Stanford U., Calif.
POSTBUCKLING BEHAVIOR OF A CIRCULAR CYLINDRICAL SHELL THAT BUCKLES LOCALLY UNDER AXIAL COMPRESSION
Masuji Uemura May 1963 78 p 13 refs
(NASA Grant NsG-93-60)
(NASA CR-50927; SUDAER-156) OTS: $7.60 ph, $2.54 mf

In view of the experimental evidence that localized diamond-shaped buckling patterns are usually observed in the buckling of cylindrical shells under axial compression, the postbuckling behavior of such shells is analyzed by the use of

an asymptotic unperiodic function, instead of the periodic buckled pattern previously used by other investigators. After determining the arbitrary coefficients in the deflection pattern so as to satisfy the conditions of continuity along the center line, the postbuckling behavior is determined by the method of solution previously used, that is, from the minimum condition of the total potential energy and total strain energy with respect to several parameters for the case of dead-weight loading and for the case of rigid-testing-machine loading, respectively. The analysis shows that nearly square diamond-shaped and damped (in other words, localized) buckled patterns, as usually observed in experiments, give the minimal values of the energy. The minimal value of the buckling stress obtained is higher than the values obtained for the periodic buckled pattern.
Author

N63-21055 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF TRANSTABILITY CONCEPT TO FLUTTER OF FINITE PANELS AND EXPERIMENTAL RESULTS
Sidney C. Dixon (M.S. Thesis, Va. U.) Washington, NASA, Sept. 1963 36 p 21 refs
(NASA TN D-1948) OTS: $1.00

The governing differential equation was solved by the Galerkin method. Numerical results obtained from four-term solutions are presented for both clamped and simply supported panels with various length–width ratios and various ratios of lateral to longitudinal midplane stress. Experimental data are presented for essentially clamped panels with a length–width ratio of 4. Tests were conducted at a Mach number of 3.0, at dynamic pressures from 1,600 to 5,000 lb/sq ft, and at stagnation temperatures from 300° to 650° F. The results revealed that the flutter characteristics are very sensitive to the panel buckling characteristics. Both theory and experiment indicated that existing experimental panel–flutter envelopes can be inadequate as flutter criteria for stressed panels.
Author

N63-21065 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLUTTER OF FLAT RECTANGULAR ORTHOTROPIC PANELS WITH BIAXIAL LOADING AND ARBITRARY FLOW DIRECTION
Herman L. Bohon (M.S. Thesis, Va. Polytech. Inst.) Washington, NASA, Sept. 1963 35 p 18 refs
(NASA TN D-1949) OTS: $1.00

A theoretical analysis is presented on the flutter of simply supported orthotropic panels at supersonic speeds. Modified piston theory is employed for the lateral loading. Flutter boundaries show that orthotropic panels are highly sensitive to small changes in flow angularity. Rotation of the panel causes a change in the critical flutter mode which results in a stable region completely bounded by an unstable region. There are stress ratios for which very large thicknesses are required for prevention of flutter once the panel undergoes the mode change.
Author

N63-21169 RAND Corp., Santa Monica, Calif.
REVIEW AND ANALYSIS OF CUMULATIVE-FATIGUE-DAMAGE THEORIES
Lloyd Kaechele Aug. 1963 90 p 14 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3650-PR)

An investigation of the basic concepts of cumulative damage and a comparison of several current cumulative-fatigue-damage theories are presented. It is shown that cumulative-damage theories can be categorized by determining the basic assumptions they contain regarding (1) how to properly add together the damage produced by each stress cycle, when many different cycles are mixed together, and (2) how damage progresses at one stress level. Several current cumulative-damage theories are examined and compared in terms of prediction of fatigue life under spectrum loading. The important consequence of differences in the theories considered is not different predicted lives, but rather differences in the amount of material that will provide a specified lifetime, as found by application of the theories in design.
P.V.E.

N63-21211 College of Aeronautics, Cranfield (Gt. Brit.)
THE FLUTTER OF THIN, PLANE, ELLIPTIC PANELS
D. J. Johns, R. J. Davies, and G. H. F. Nayler Jan. 1963 23 p 13 refs
(CoA-N-136)

The effect of various parameters on the flutter of elliptic panels is studied by simple theoretical analyses. For clamped-edge panels, compressive membrane stresses are shown to have destabilizing effects. Structural damping is, in general, destabilizing, except for very low values of the ratio of structural and aerodynamic damping coefficients. The addition of a concentrated mass may also have a destabilizing effect, depending upon the position of the added mass. The effect of sweepback is stabilizing or destabilizing, depending on whether the panel aspect ratio is less than, or greater than, unity. The effect of variations in the edge conditions is shown for the case of circular panels, where the difference between simply supported and fully clamped edges corresponds to a difference of 20% in critical panel thickness.
Author

N63-21283 Columbia U., New York, N.Y.
A GENERALIZED THEORY OF STRAIN-RATE-DEPENDENT PLASTIC WAVE PROPAGATION IN BARS
Jacob Lubliner Aug. 1963 20 p 18 refs
(Contract Nonr 266(86))
(Tech. Rept. 33; CU-3-63 ONR-266(86)-CE)

A theory of plastic wave propagation in bars is formulated on the basis of a general quasi-linear constitutive equation. It is shown that the strain-rate-independent and strain-rate-dependent theories are special cases of the generalized theory, and conditions are shown under which one or the other may be valid.
Author

N63-21285 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE EFFECT OF AXISYMMETRIC IMPERFECTIONS ON THE BUCKLING OF CYLINDRICAL SHELLS UNDER AXIAL COMPRESSION Technical Report
W. T. Koiter Aug. 1963 25 p 10 refs
(LMSC-6-90-63-86)

A cylindrical shell with axisymmetric imperfections always has an axisymmetric configuration of equilibrium under uniform, axial, compressive loads. The present paper discusses buckling of this symmetric configuration into a nonsymmetric form. The analysis is based on the nonlinear equations of shallow shell theory, which may be linearized for the investigation of neutral equilibrium in the symmetric configuration. Only those buckling modes are considered which are periodic in the axial direction as well as in the circumferential direction. The numerical evaluation is restricted to imperfections in the shape of the axisymmetric buckling mode of a perfect cylindrical shell. The present analysis fully confirms the predictions of the general nonlinear theory of elastic stability developed earlier.
Author

N63-21327 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLUID IMPACT CRATERS AND HYPERVELOCITY -- HIGH-VELOCITY IMPACT EXPERIMENTS IN METALS AND ROCKS
H. J. Moore, R. W. Mac Cormack, and D. E. Gault May 1963 34 p 20 refs
(NASA CR-51340) OTS: $3.60 ph, $1.22 mf

The impact phenomena of hypervelocity and high-velocity projectiles with rock and metal targets are studied and a comparison is made of: (1) fluid-impact craters produced by water drops impacting water, (2) hypervelocity and high-velocity impact craters produced by impact of steel, aluminum, and polyethylene projectiles with basalt, and (3) hypervelocity and high-velocity impact craters in metals. It is concluded that shear strength or compressive strength of the target material is a more realistic parameter than acoustic velocity. When acoustic velocity is used as a parameter, water-drop cratering experiments cannot be correlated with theory, or with experimental data on high-velocity to hypervelocity impact cratering in rocks and metals. P.V.E.

34 STRUCTURAL DESIGN

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

N63-21068 Chance Vought Corp., Dallas, Tex.
METHOD OF MATERIAL EVALUATION FOR DESIGNING SEGMENTED SPHERE VESSELS
J. W. Farrell [1963] 12 p 4 refs

The segmented-sphere pressure vessel is an interesting composite structure which offers high volumetric efficiency and a higher structural efficiency than an equivalent simple sphere. Its potential advantages have not been fully exploited since unfamiliarity with the design parameters has handicapped engineers attempting to assess specific applications. Author

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